

AVIATION WEEK

A MCGRAW-HILL
PUBLICATION

December 2, 1957 75 cents

Pilot Report:
Tri-Pacer Floats
Add Versatility



Fairey Rotodyne

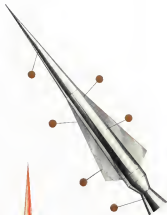
Design Details of Firesteak Missile

The Rheem Electronic Division is engaged in the design, development and production of ground based test and instrumentation equipment on current missile programs.

Three missile models, Kinetic: System checkout during production, The Flight system checkout (ITE), In Flight Monitoring and range instrumentation.

Rheem Electronic is also providing airborne systems, data processing systems, visual training devices and trainer simulators on current missile projects.

ELECTRONIC DESIGN
MISSILE MANUFACTURING
COMPANY Azusa, California



specification:
maximum
dependability

every fighter, every bomber, every transport is Hydro-Aire equipped.



McDonnell F-4H Phantom II

HYDRO-AIRE is
Standard
Equipment
on the F-4H

hytrol

When the cost of failure is too high, when maximum dependability is the most important part of the specification—the answer is HYTROL.

Super-sonic fighters come in too fast for human reaction to get a "Yes" for the braking action. However, that's exactly what HYTROL does for you.

- The answer is HYTROL.
- No maintenance due to chocking.
- 30% more life wear.
- Safety that pays off in dollars.
- Safety that can't be measured in dollars.
- Maximum protection against overheating, swelling, or late release reactions.
- Maximum protection against oil, rust, shock or wear.

HYTROL—the accepted Anti-Fluid Braking System is standard equipment on the B-47, B-42, A-10, B-58, RF-4B, F-105, C-130, QF-40 and has been proved on more than 50 different types of aircraft.



HYDRO-AIRE

HYDRO-AIRE, INC., 1000 NORTH MAIN

The aviation technology of

CRANE

SARGENT

HYDRAULIC
PNEUMATIC
MECHANICAL
ELECTRONIC

SYSTEMS OF FORCE CONTROL

Sargent Systems of force control are backed by more than 37 years of experience building precision equipment to meet the increasingly high requirements of the aircraft, guided missile, petroleum, gear and machine tool industries.

If your application of force control deals with aviation, marine, surface or subsurface movement, we invite you to send your requirements for the Sargent design, qualification and manufacturing proposal.

"GOOD WILL" is the objective of the planned customer to return to the place where he has been well treated.
— U.S. Supreme Court

Standard of Excellence

Sargent offers exceptional opportunities to engineers interested in design, development, qualification, testing and manufacturing of advanced force control systems. Send your resume immediately on confidential to Chief Engineer.



Since 1920

ENGINEERING CORPORATION

MAIN OFFICE & PLANT • 2523 E. FIFTY-FOURTH ST.

HUNTINGTON PARK, CALIF.

AVIATION CALENDAR

- Dec. 14th—Annual Meeting, American Society of Mechanical Engineers, Section on Aircraft, Midway Hotel, New York.
- Dec. 24th—Aerospace Society, annual meeting, Grand Hotel, New York.
- Dec. 34th—Honeywell Instrument Engineering Institute of Radio Engineers & Institute of Electrical and Electronics Engineers, Philadelphia, Pa.
- Dec. 4th—Capacitors and Techniques of Airplane Assembly for Limited War, 5th Annual Preparation Meeting, American Ordnance Assn., Donald A. Quisenberry, Director, Institute of Defense Studies, 1000 West 10th St., New York.
- Dec. 4th—Symposium on high temperature stress upon Aluminum Structures, Institute of Aeronautics, Philadelphia, Pa.
- Dec. 9th—1947 Eastern Joint Computer Conference and Exhibit, Statton Park Hotel, Washington, D.C.
- Dec. 26th—1st Traffic Control Symposium, The Motion and Methods of the Airway Modernization Board, sponsored by Frontier Institute, Philadelphia, Pa.
- Dec. 15th—Gas Turbine Development Conference, New York City, sponsored by U.S. Navy, Air Development & Material Center at Wright-Patterson Field, Dayton, Ohio.
- Jan. 6th—1st Annual National Symposium, Air Force Research and Development, United States, Washington, D.C.
- Jan. 13th—1948 Annual Meeting, Society of Automotive Engineers, National Conference and Exhibit, Statton Park Hotel, Washington, D.C.
- Jan. 14th—1948 Symposium on the Design and Development of Aircraft, sponsored by American Society of Mechanical Engineers, Philadelphia, Pa.
- Jan. 20th—1948 Symposium on the Design and Development of Aircraft, sponsored by American Society of Mechanical Engineers, Philadelphia, Pa.
- Jan. 20th—1948 Symposium on the Design and Development of Aircraft, sponsored by American Society of Mechanical Engineers, Philadelphia, Pa.

AVIATION WEEK • DECEMBER 2, 1957

Vol. 47, No. 22

Aviation Week is an annual event, held in New York City, December 2-5, 1957. It is a major event in the aviation industry, bringing together representatives of the industry, government, and the public. The event includes a variety of activities, including seminars, conferences, and exhibits. The main theme of the event is the development of new aircraft and the improvement of existing ones. The event is held at the Waldorf Astoria Hotel, which is one of the most prestigious hotels in New York City. The event is open to the public, and tickets are available for purchase. The event is a major event in the aviation industry, and it is one of the most important events of the year.

Information about the event is available in the Aviation Week directory, which is published annually. The directory lists the names and addresses of the companies and organizations that are participating in the event. It also lists the names and addresses of the speakers and exhibitors. The directory is a valuable resource for anyone who is interested in the aviation industry.

Aviation Week is a major event in the aviation industry, and it is one of the most important events of the year.

TRANS-SONICS

INC.

ELECTROSET[®] PRESSURE SWITCH

Remotely adjustable
without a Servo System



SPECIFICATIONS

- RANGE: Adjustable 0 to 10 psi to 75000 psi
- REPEATABILITY: ± 1 psi
- ACCURACY: ± 0.5 psi
- ADJUSTMENT: 50 g in any direction
- VIBRATION: 20 g to 2000 cps
- WEIGHT: 14 oz
- TEMPERATURE RANGE: -125° to $+150^{\circ}$ F
- SWITCHING CURRENT: 1 ampere resistive load

Operates under severe environment from atmospheric pressure to vacuum with accuracy of 0.5%.

The Electroset Pressure Switch offers a new and easy way to calibrate and set a pressure switch from a remote position. The switch is automatically adjusted simply by applying the desired switching pressure and momentarily energizing a solenoid. When the solenoid is energized, one contact is securely clamped while the other contact remains free to move with changes in pressure. Once set, the switch will open at pressure below the clamping pressure and close at pressure equal to or above the clamping pressure.

The Electroset Pressure Switch is vacuum sealed, notched from dust, moisture or corrosive fluids, including the fluids used to actuate it. It is ideally suited for industrial process control applications where an adjustable switch must be located in a remote or inaccessible location or where the switch must operate in an atmosphere which would degrade the performance of a non-hermetically sealed unit. Among military applications are testing of weapons and control of aircraft or missiles. Write for Technical Bulletin 1570 to Trans-Sonics, Inc., Dept. 3, Burlington, Massachusetts.

TRANS-SONICS

Precision Transducers

Our biggest asset can't be photographed

What's inside this engineer's mind? A camera never reveals that for 30 years a trained mind has been accumulating a vast fund of knowledge on gyroscopes and has some fresh wild and original thinking on orbital guidance.

No photograph can tell that another man thoroughly grasps the present state of the art in infrared technology and has new ideas for the future.

We can't show pictorially the knowledge and reasoning ability other staff members bring to such subjects as radar, mineral detectors, semi-conductors, computers, mechanical design, and

all the other fields of competence that go to make up a balanced research and development facility.

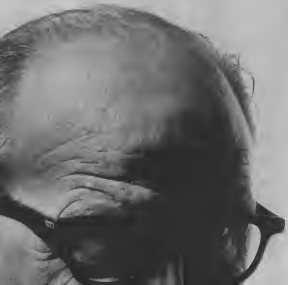
Now can we show the special types of snap switch that make a few class systems engineers, a top production team, or a forward looking executive to keep these specialists functioning smoothly as an integrated organization.

But we can tell you what these people have done in the past, what they are doing now (where military security permits), and what we believe they can do for you. Write Dept. MK Mechanical Div., General Mills, 1605 Central Ave., Minneapolis 13, Minn.

MECHANICAL DIVISION

Circle 40 Research and Development • Design Engineering and Production

General
Mills



Now...SEALED DEPENDABILITY IN AN EXCLUSIVE DOUBLE-POLE SWITCH



HERMETICALLY-SEALED DOUBLE-POLE SWITCH



MODEL 20-A
ACTUAL SIZE

Seals Out Moisture, Dirt, Oil, Corrosion, Condensation from Temperature Cycling



With switch mechanism hermetically sealed in a dry, inert gas, switch is dependable at any altitude, moisture or temperature condition. Will it in aircraft, machines where oil is a problem, in areas subject to freezing or extreme heat or other adverse conditions.

Controls FOUR Circuits with ONE Snap



Logic separates controls and hermetic panel mount universal circuit combinations. May be wired as normally for 0-PST, 2 circuit, 0-PST, normally open 0-PST, normally closed. Hermetic poles may also be wired universally to utilize the hermetic control capability of switch to handle all control loads for high voltage switching.

Eliminates Expensive and Bulky Relays, Extra Switches



2/4 one control circuit combines four that were formerly possible only with duplicated relays or a number of separate switches. Saves money, weight and space.

Starts, Stops or Reverses Three-Phase Motors



Simultaneous action of two hermetic poles permits switch to break or connect current flow through two windings of a three-phase motor. Hermetic poles are insulated by unique design of switching mechanism, eliminating need of added heat.

SPECIFICATIONS



Standard Designation: snap 0-115/20W-
400-100-100
Mounting: Pre-wired to fit
Weight: 0.15 oz. 14 in. with terminal

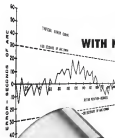
SWITCH ACTUATOR
Control or emergency control may be
incorporated on switch. 1/4" diameter
snap switch mounting.

*****WRITE FOR CATALOG DETAILS*****
ELECTRO-SNAP SWITCH & MFG. COMPANY
Attention: 1615-14-1011 N. Lake St., Chicago 16, Ill.
Please send full information on new 0-1-A hermetically sealed
Simultaneous Double Pole Switch.

Name: _____
Company: _____
Street: _____
City: _____ State: _____

SYNCHROS

WITH NEW STANDARDS OF ACCURACY



KEARFOTT NEW SIZE 25 SYNCHRO is accurate to 0.5 minutes of arc. It requires no external compensating device. Available as transmitters, control transformers, differentials and resolvers.

SIZE 33 "PANCAKE" SYNCHROS are suitable for gunball mounting and are accurate to 2.5 minutes of arc.

SIZE 11 SYNCHROS for 4 wire systems offer accuracy of 3.0 minutes of arc. Standard 3 wire Synchros available with 5, 7 and 10 minute maximum errors.

ACTUAL SIZE

SIZE 25
MAXIMUM ERROR
30 MINUTES FROM 0.2



SIZE 11



SIZE 33

KEARFOTT COMPONENTS INCLUDE: Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Resolver Gear Assemblies, Navnetic Rotary Resolvers, Indicators and other Electrical and Mechanical Components.

KEARFOTT SYSTEMS INCLUDE: Directional Gyro Compass Systems, Slave Gyro Stable Platform Systems and Inertial Navigation Systems.

Particulars on these and other Kearfott Components gladly sent on request.



KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

Sales and Engineering Offices: 5215 Main Avenue, Clifton, N. J. Montreal Office: 22 W. Columbia Ave., Le Grange, Ill.
Branch Offices: 6111 Horton Drive, Dallas, Texas West Coast Office: 313 N. Yuma Avenue, Pasadena, Calif.



here's the inside story...

1. Reservoir assembly plate valve

2. Pressure regulator assembly valve

3. Regulator and bypass valve

4. Check valve

5. Reservoir and relief valve

6. Pressure indicator

the new dimension in component packaging!



Weston's Pneumatic Actuator Control Valve Package Combines 6 Components in a Single 6.4 lb. Unit!

While controlling the pneumatic actuator, this weight and space saving valve also provides for snubbing pressure at the opposite end of the stroke. It affords extremely fast operation (maximum at .04 seconds) and low leakage (10 cubic inches per hour). The selector valve is non-overflow and detented to maintain position. If you have a weight and space problem, let Weston's team of specialist package engineers solve your specific application.

weston  a subsidiary of Borg Warner Corporation
HYDRAULIC LIMITED 3000 Lakeside Blvd., North Hollywood, Calif. 91605, U.S.A.

Export Sales: Borg Warner International, 34 South Wabash Ave., Chicago 3, Illinois
Export Representatives: Mr. W. R. Buckle, 14 South River Lane, Glas-Bank, New Jersey Telephone: G1804 4 2019
Milward Representatives: Mr. E. A. Pomeroy, 13317 Pennings Drive, Northwest Missouri Telephone: 753-0506 6481

For speed

plus **VISIBLE SAFETY**

Airloc by MONADNOCK *TWA JETSTREAM* by LOCKHEED



From the passenger's point of view, TWA's giant Jetstream[®] is a reassuring sight. Its speed, range and reliability are visibly confirmed by its four engines and its tremendous size.

From the mechanic's and flight engineer's point of view, Monadnock's famous Airloc panel and covering fastener offers even greater assurance of safety. It not only acts fast

and looks positively... it sticks its neck out when it's not locked so that anyone can tell immediately whether it's secure or not.

Available in a range of sizes with flush, round or wing-type heads and with or without an air and moisture-proof seal, Airloc conforms to USAF Spec. MIL-F-5501 and is widely used in service and civilian aircraft of every type.

*Airloc is a service mark owned by TWA exclusively



Subsidiary of UNITED-CARR FASTENER CORP.
Cambridge 42, Mass.

There's
only one snowflake
like this ❄



and there's
only one trade-mark
like this ❄

TIMKEN[®]

THERE'S only one Timken and it's a registered trade-mark—stamped on every Timken Company product. It means the name "Timken" is the property of The Timken Roller Bearing Company alone.

It means even more to you. When you say "Timken", you know you'll get the highest quality tapered roller bearings, line alloy steel bars,

caseless steel tubing or removable rock bits—all products of the Timken Company. Industry has made it a habit to look for the trade-mark "Timken" when looking for quality and value. It's a name with more than 55 years experience behind it. A name 15,000 Timken Company employees work very hard to keep on top.

That's why it pays to remember that "Timken" is a trade-mark, not just a type of product.

So to be sure you get the best, look for the trade-mark "Timken". It's your assurance of quality.

The Timken Roller Bearing Company, Canton 6, Ohio, Canadian plant: St. Thomas, Ontario, Cable address: "TIMKENSOC".



TAPERED ROLLER BEARINGS • REMOVABLE ROCK BITS • FINE ALLOY STEEL



How long can you rely on any aircraft battery?

SILVERUM RESISTS CORROSION



Silverum alloy grid after corrosion test.



Nickel-plated grid after same test.

Here's the bottom answer:

You can rely on your battery only as long as it still has its rated capacity and its grid is still intact. And only the Exide Aircraft Battery has those three built-in safeguards to insure long reliability:

1. **Silverum® grids.** So resistant to long life overcharge damage, they usually outlast the battery.
2. **GGA® active material.** Ultra-fine particles pack more power per outer... insure high output to meet heaviest loads.
3. **New Formex separators.** 25% more porous to electrolyte. Improve battery's ability to handle constant heavy loads.

Remember, you can't see a grid corroding. And when it fails, it gives no warning... might easily cause an embarrassing instant delay. Be safe. Insult Exide batteries.

They cost no more than batteries that don't give you their protection. Call your nearby Exide office. Or write Exide Industrial Division, The Exide Storage Battery Company, Phila. 2, Pa.

Circle 10

Exide®

SIoux

on the war path..



The Army Sioux (the Bell H-13) has faced battle more than once. In Korea it evacuated more than 18,000 United Nations troops under enemy fire. In Algeria, today, it is repeating its warrior role for the French Army. It is serving our own armed forces here and abroad.

We hope American military men are never again called to fight. But if they are you can be sure that the Sioux will go on the war path; for battle demands proven ability... the kind of ability engineered and built into the H-13... the kind of ability that has resulted in more than 2,500,000 hours of flight experience.

When there is a job for the helicopter to do, in peace or war, the Bell will do it best. That was true yesterday. It is true today. It will be true tomorrow.

Watch "WHIRLYBIRDS" on TV - search your local paper for time and station.

BELL H-13H FEATURES:

1. Longest approved overhead period.
2. Interchangeable metal blades.
3. Cyclic boost (power steering) that disengages latest Bell designed and developed lock and load valves.
4. Specialized elevator that permits greatest range of useful loading without battery or boiler shift.

DERATED ENGINE PROVIDES

1. Improved hot weather and altitude performance.
2. Maximum operating period between overhauls.
3. Reduced maintenance and greater reliability.
4. Reserve power for emergencies.
5. Maximum availability — Minimum cost.





BOAC TURNS TO **LINK** FOR ITS 707 JET SIMULATOR

Link equipment has been selected to train the flight crews of another great jet fleet—the huge 707 jetliners serving the world-gringing routes of British Overseas Airways Corp.

BOAC crews will get realistic jet flight experience in their forthcoming Link 707 simulator well in advance of their first "for real" flights in the actual aircraft.

Link Aviation, Inc.—a name which has always been synonymous with the latest and best in electronic flight training equipment—continues to be the choice of the leaders in the jet transportation field.



LINK

AVIATION, INC.

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

25 JANTON, NEW YORK



new AMP wire splice team

cuts costs in

aircraft and
electronic industries.

On-plate construction and precision tooling now application time to shakedown extension while guaranteeing perfect, permanent mechanical and electrical connections.

Three and one-half years of engineering research have developed the following features:

Color Coding of both connector and tooling
... accurate electrical matched wire sizes of wire,
after cut tooling

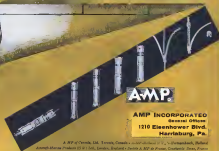
Noncircular connector windows

... accurate position wire depth fit tested

Insulation ports on ends

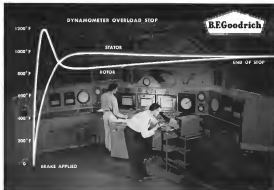
... plasticity against bond elasticity

... plasticity against bond elasticity



AMP INCORPORATED
General Office
1210 Eisenhower Blvd.
Harrisburg, Pa.

A AMP of Canada, Ltd., Toronto, Canada is a wholly owned subsidiary of AMP, Harrisburg, Pa.
Joseph Morris Products (S) S. Ltd., London, England • Distributors AMP of France, Compagnie, Paris, France
General Precision Products Co., Ltd., Taipei, Taiwan



THERMAL BALANCE makes B.F. Goodrich Disk Brakes stop faster, smoother. Here's graphic proof!

Study the chart above and you will see how built-in Thermal Balance enables the new B.F. Goodrich Disk Brake to operate more efficiently—with fewer "hot spots," less chatter."

Thermal Balance—a function of proper design—is equalized heat distribution throughout the metal parts of the brake in proportion to their respective capacities. This concept is the result of BFG possessing the use of electrical testing components in brake design.

Because of the B.F. Goodrich Disk Brake's Thermal Balance, heat energy spreads rapidly and uniformly from the friction surfaces on the rotor and stator surfaces, eliminating warpage and uneven wear caused by hot spots. This means longer brake life.

These benefits of thermally balanced design are reasons why aircraft manufacturers and airlines are choosing the B.F. Goodrich Disk Brake for their advanced planes. Diverse tests in the laboratory and in actual flight operations have proved that this new brake has more efficient heat sink area—a higher capacity for heat, safe stops—than any other brake on the market today.

To incorporate the advantages of Thermal Balance in your braking system, contact B.F. Goodrich Aviation Products.

B.F. Goodrich Aviation Products
a division of The B. F. Goodrich Company, Akron, Ohio



Thermal Balance produces this constant rate of speed in case "brake fade" sets in smoothly without fluctuations.



Constant torque during stop proves the BFG Disk Brake dissipates changing vibrations.

EDITORIAL

What We Really Need

In the three months passed since the Soviet Union announced it had successfully flight tested an intercontinental ballistic missile there has been an enormous amount of talk in this country as to what we should do to attain or reestablish our overall scientific and military parity of superiority. This talk has been punctuated by the launching of the 164 lb. Soviet Sputnik I on Oct. 4—the first successful placing of an artificial satellite in an orbit around the earth—and the launching of the 1,230 lb. Sputnik II early in November carrying a dog. By the time this editorial reaches our readers, the Soviets may have Sputnik III in the sky carrying monkeys or an orbiting ape.

We now have several committees of Congress investigating our scientific and military progress, and it is a law legislator who has not come up with some sweeping proposal to solve our military and scientific problems. A missile " czar," a Secretary of Science in the Cabinet, single managers of new weapons development, federal industry for science students and a single military service are among the proposals being peddled on Capitol Hill and throughout the provinces.

Wilson Heritage

But with all of these strong words blustering throughout the land, there has been precious little action. The positive action taken by Defense Secretary McElroy (AW Nov. 14, p. 21) has simply restored the status quo that existed before Mr. Charles E. Wilson took his final shot at the research, development and weapons procurement budgets last summer. Mr. McElroy certainly can not be expected to unravel the Pentagon's "case of worms" he admitted in the few weeks he has been on the job.

Continuing through the Washington scene and particularly the Pentagon, we are unable to find a single concrete example that indicates business is not being done as usual without any real change from the deathly complacent attitude that enveloped the executive branch of the government before the Soviets so dramatically demonstrated their long range missile capability.

Mr. McElroy's reassured decision last week of putting both the experimentally built Arise Japan and the production engineered USAF Thor IRBM into production is simply a continuation of the wasteful duplication that will upend all funds totally needed for new advanced projects. There has been no implementation of the money doing and technically sound space program that has been gathering dust on Air Force and aviation manufacturers shelves for the past three years. There has been no real loosening of the purse strings in the

widest basic research area where the monetary costs are low but the potential rewards in technical progress enormous. There has been no real effort to allocate the critical problems of Strategic Air Command such as lack of new and younger transit crews, dispersed bases and facilities to maintain a constant alert.

Action, Not Blame

But there has been a vigorous effort to pin political blame for the current situation on both the Republican and Democrats. This is a further accusation because the blame must be shared equally. The cause question of a failure to act immediately and vigorously now will be shared equally by all citizens of this land regardless of their political convictions or indifference.

It is no historic fact that the Democratic administration when Harry S. Truman was President cut the heart out of the ballistic missile development program as well as the expansion of the Air Force and naval support, began the ridiculous national security program that alienated scientists from the defense effort and lowered our military posture so blatantly that the Soviet Union felt safe in beginning armed aggression against Korea. It is equally historic that the current Republican administration has failed to heed the recurrent warnings of the race of Russian military technology and has pursued a narrow fiscal policy that has critically and seriously retarded our ability to surpass the Soviet's pace.

So there can be no political profit in a switchboard through the past war decade to affirm blame for our present plight. What we really need may not be as easy as drastic or complex as many of the remedies now suggested.

Frank Appraisal

This country suffers from no dearth of scientific talent and industrial capacity. There is no reason why this country cannot maintain a technical superiority in the new military technologies without any serious threats to its economic stability.

It may be that what is really needed is nothing more than a clean cut ban on national leadership stating our current problems frankly and without any attempt to conceal or gloss over their gravity followed by a direct exercise of leadership by the responsible officials through streamlined channels that avoid the mazes of advisory committees and stagnant pools of bureaucracy and provide the scientific and industrial talent with the encouragement and financial support they need to do their job. It may be as simple as all that.

—Robert Eklot



TITANIUM METALLURGY IN MOTION

In developing aircraft of higher and higher performance, the aircraft industry also created the demand for increasingly high-performance alloys. With the industry's co-operation, Rem-Cru technical teams developed most of the basic *titanium alloys* in use today, and are producing them in tonnage quantities to meet aircraft quality standards.

REM-CRU
TITANIUM

World's Most Versatile Metal

The July issue of the REM-Cru Review is devoted to special metals. Ted Meyers, North American Division, is guest editor. Write Dept. A-10 for your copy.

MIDLAND, PENNSYLVANIA

Sales Office: 4155 101st Street, Bedford, Massachusetts 01730 • 601 N. Orchard Street, Chicago 24, Illinois • 405 Lexington Avenue, New York 17, N. Y.

WHO'S WHERE

In the Front Office

By S. Beebe, president, Rusti Aircraft Mfg. Corp., Norwalk, Conn.

Robert W. Tait, assistant Paul H. Rait, two, named as president of each of the operating companies of the *Aerotec* Ten-year Corporation of Manhattan, New York, N. Y.

Thomas E. Moffitt, president, Hinkley Electronics Div., Dayton, Ohio, N. Y. M. Moffitt succeeds *Agnes Klemke* as president.

A. V. Roy, Canada Ltd., Toronto, Canada, has appointed the following executive vice presidents: **Walter E. McLaughlin**, administration and coordination; **Frank T. Szymanski**, A. C. MacDonald (under trial).

Glenn G. Whitaker, vice president, Sierra Tool & Mfg. Co., Inc., Glendale, Calif.

Clinton L. Miller, assistant vice president operations, Alaska Airlines, Inc.

Honors and Elections

Donald G. Fish, Director of Research of the Polys Corp., has been elected president of the Institute of Radio Engineers for 1978. His first assistant is **John T. Hendricks**, principal research officer of the No. 600 Research Council, Ottawa, Canada.

Changes

Dr. Leland E. Arter, senior scientist, Mechanics Dept., Hamilton Standard, a unit of United Aircraft Corp., Broad Brook, Conn.

Robert W. Koenig, general manager, Air Analysis Service Co., San Francisco, Calif.

Robert L. Bell, assistant manager in sales, engineering and design, S. Koshaba, director sales and marketing, Vantage, 10000 Route 100, San Jose, Calif. 95128. **Robert S. Koenig**, director of engineering, Union Division, Honda America Corp., Upland, N. Y.

Paul L. DeCoursey has joined the corporate staff of Lattice Industries, Beverly Hills, Calif. Mr. DeCoursey will handle new development planning activities.

Gerold M. Hershman, director of engineering, and **Frank P. Driscoll**, Jr., director of marketing services, Aerotech Systems, Inc., Norwalk, N. Y.

Stanley R. Jones, chief engineer, Morgan Manufacturing Division of Morgan Products Industries, Inc., Colton, Conn. **Carl Albert W. Brundage**, manager, Foreign regional sales office (French Switzerland), Continental Electronics Corp., Pasadena, Calif.

Joseph E. Gilman, manager, Instrument Division, Eldec Electronic Products, Inc., Plainfield, N. J.

Jeffrey Gilbert, chief development engineer, Temp Manufacturing Co., Los Angeles, Calif.

John R. Kane, master project engineer, Coleman Division, North American Aviation, Inc., Columbus, Ohio.

INDUSTRY OBSERVER

► Russian may launch satellite carrying an atomic clock to obtain experiment verification of Einstein's general theory of relativity. General theory holds that a precise clock will run more slowly at infinite altitude than on earthbound clock because of differences in gravitational fields. Speed theory holds that rates of two clocks will vary because of relative motion between the two. Predicted difference in clock rates is so small that verification was not feasible prior to development of extremely accurate atomic clocks and stability of altitude and speed differences now available with such satellites.

► Watch for large scale layoffs in engineering department of Douglas Aircraft's Santa Monica Division after the loss of the new Eagleman's program is almost complete on the DC-8 and DC-7, and United Airlines' decision to purchase the Boeing 707-720 rather than the DC-9 ended off the last hope of having a new aircraft for Santa Monica before the tail of the work on propeller driven planes.

► More than 5470 dollars has been spent to date on overall test facilities for USAF's Atlas and Titan intercontinental ballistic missiles and the Thor intermediate range ballistic missile.

► Watch for closer steps between U. S. and German aircraft manufacturers, using German design and development talent to find American production capabilities. Both Lockheed and North American have been discussing such arrangements with German firms. German and Republic are also reportedly interested. In some cases competition would be contingent upon German refusal of U. S. company's product. One U. S. company's plan would start with German joint design, modification, engineering, special installation or assembly. Company would later find component and complete design data through German prototype of fabrication to American production lines.

► Caswell Aeronautical Laboratory is working on a Problem of All-Weather Carrier Operations (PACCO) system for Navy's Bureau of Ships. System attacks the problem of bringing many fast, low-on-board aircraft back to port and aboard a carrier in fast and as early as possible under any weather conditions.

► Navy's Ballpark air-to-surface missile complex, extensive target guidance system which handles on enemy radar signals, making it effective against a variety of land or water-based targets. Ballpark is being built by Martin's Orlando, Fla., division.

► Boeing KC-135 jet tanker, in record high gross weight flight test, from Edwards AFB, Calif., started test at 307,000 lb. gross, take off at 297,000 lb., had 400 ft. altitude and 240 kt. steeped by the time water was exhausted or bailed.

► Crash-built, Russian designed MC-15s were offered in three or four for its re-equipment program and rejected. Soviet nation and the price was good but unacceptable because the aircraft is obsolete. Reported at the time there will be the same reason with North American F-8E Sabrejets. Soviet now hope to buy 100 Hawker Hunter F-6 aircraft for 1979 delivery as first steps in re-equipment program (AWN Nov. 25, p. 27). Soviet also announced in Chinese Wright F1U-2s (AWN Nov. 25, p. 28).

► Army is manufacturing 15 VUH-21 helicopters for all-terrain flying. Of these, 13 will be retrofitted from 1976 production, 20 constructed on the production line. Helicopters will be assigned to Fort Rucker, Ala., for introduction into Army's helicopter astronaut flight training program.

► General Electric for shipboard installation is being developed for Navy by Glynn Eichen. System will be used to make girths, maps of the world.

► Fight for German air force orders is still hot, with U. S. airlines facing high technical competition from Dassault's Mirage M. Sales and engineering trend led by the Germans may hold the key to a large export market and that, if they buy, the Swiss and Dutch may follow suit in short order. Japan probably would be the next major customer.

Thor Designed for Fast Mass Production

Components, experience gained in ICBM programs are utilized to give USAF a reliable, available IRBM.

By Irving Stone

Los Angeles—Air Force Thor intercontinental range missile was "designed down" from USAF's intercontinental ballistic missile projects to get reliable IRBM as fast as possible.

Thus, inspired by Art Kesteven and Development Command's Ballistic Missile Division for operation, was designed from the start as a production type weapon system. It was assigned to Ballistic Missile Division because it appeared that a good operational IRBM could be produced faster by utilizing component developments of the ICBM instead of developing the shorter range missile from scratch, with all the attendant cost delay.

ICBM Tie-In

This "designing down" approach is in Thor closely with the Deimos's ICBM, the Convair Atlas and Martin Titan, and Rando-Woodbridge Corp. has responsibility for technical direction and systems engineering for the new Douglas Aircraft Co. as prime contractor for Thor.

As yet to have conversations between all three of these weapons systems. One example is that, with major variations, the logistics plan is better for all three systems.

Consequently, operational aspects gathered with Thor will be cranked back into the Atlas and Titan programs.

This approach has made possible these relationships to develop reliability and advance the weapon's operational status.

A propulsion system is "half" the Atlas booster powerplant, which originally had 175,000 lb thrust launch (AWJ June 24, p. 32) but were reduced to 100,000 lb each. This puts more than a year of ICBM propulsion experience into Thor and transfers current ICBM propulsion tests into additional reliability for Thor. Army's Jupiter also uses the Air Force sponsored North American Rocketdyne engine that is in Thor.

A nose cone is the same as the ICBM's. Because the nose cone has been designed for the more stringent ICBM service, it undoubtedly will track the IRBM stages. Thus, heating is roughly proportional to the square of the range and cutting the ICBM range down to that of the IRBM will mean that the nose cone will not deteriorate about one-quarter of the distance.

• Guidance has been taken directly from that developed for Atlas ICBM.

With these basic elements established from ICBM experience, it was only necessary to introduce the unique coordinating element—Douglas's prime contractor for the Thor missile. Douglas also has responsibility for the autopilot and control system.

Use of the "designing down" approach instead of starting from scratch to achieve wide refinements in the initial design, probably means that Thor is, in a sense, overengineered. This is not a serious thing, and in one way it is beneficial. Factors that might cause some concern, such as heating and acceleration, can be taken care of by a generous margin of safety, as they generally are. Additional weight resulting is not in excess in the IRBM as it is in the ICBM, since some weight is available in the IRBM that satisfies requirements desired. Even this weight can be paid in refinements when Thor enters its operational status as available in quantity.

Extensive testing associated with Thor is an advanced base more production activities are used, passed through a regimen involving a cycle progressing from test of units to test of subassemblies, assemblies, subsystems and finally completed integrated systems.

Thor, Jupiter Ordered

Washington—Both the Atlas/Deimos Thor and Army's Jupiter intercontinental range ballistic missiles were ordered into production last week by Defense Secretary Neil H. McElroy. McElroy said that, "by making use of the production capability now available for both the Jupiter and Thor, an operational capability can be achieved by the end of 1955 in the United Kingdom."

The Defense Secretary told the Senate Preparedness Subcommittee that the decision to order both missiles into production was made after an "extensive recommendation" of the U. S. IRBM program. He said that after initial deliveries were made to Great Britain, the missiles will be sent to "other approved locations" as "soon as necessary arrangements can be effected."

McElroy testified that earlier months have gone through all test phases but that the Defense Department has been "greatly encouraged" by their success in recent tests and that they "look are at a point of which we believe we can make a sound decision to progress additional production for operational purposes."

test in the missile itself. Thus, all parts of the propulsion system have been checked out individually. The engine has been tested as a whole, and in the altitude along with autopilot and control system.

Another advantage in the design for production is that quantities are available for extensive testing. More than 10 guidance system packages were on hand before one was flown.

Thor flight tests at Cape Canaveral to date have established that the missile design is fundamentally sound and that the design/production approach has been justified. Six test Thor have been launched from mobile launchers in the last month within 13 months from November, 1955 contract date. Four of the six launch flights have been successful and at least three of the missiles first have achieved extended range distances. One report is that missile has been fired 2,845 mi. for more than military requirements.

Testing inevitably obviously cannot be replaced, but considering speed with which Thor is being built along it is safe to assume that a complete missile will be fired in very near future.

In addition to testing to produce an operational missile reliability now, Thor's design/production will facilitate maintenance of large numbers of these missiles within a relatively short time after go-ahead signal. Production is expected to be no more complicated than that for a medium fighter in even the DC-5 jet bomber.

Facilities Air Force could quickly adapt would permit maintenance of hundreds of Thors per month.

The production aspect is of top importance in view of the attitude of Secretary of Defense Neil McElroy that Britain and other U. S. allies will get U. S. built IRBMs in 1955 (see box at left).

Production Base

Thor's design has been established, proved and a production base established which could be expanded, along with highly critical training and logistic support, perhaps 10 times in a short time. Development has progressed to the point where it could be made to go into the field for operational service with acquisition is a relatively short time as ballistic missile development goes.

An indication of how the development of the weapon system has progressed is that final review of the system is scheduled to start by about 50 Air Force agencies involved with operational or support projects, to allow time to initiate detailed planning for



ATLAS test stand at Ft. Los Angeles, Calif., contains a large missile model (visible in tower screen from right), probably of heavy "bitter-sweet" type test construction, which will be used by Convair for hydrodynamic investigations, simulating effects of clothing.

except of the system, although much of this planning has already been done in a preliminary manner. This participation of interested agencies at the very beginning of the project also applies to Atlas and Titan, but approach in operational status for Thor is further advanced than in the case of the intercontinental ballistic missiles.

In comparison, Army's Jupiter is considered a "model ship" development, according to observers close to the project. Peak production rate potential of Rocketdyne Arsenal, Huntsville, Ala., where the Jupiters have been fabricated, is relatively low than other services.

Production type testing is used, but units have been fabricated as prototypes since it was never intended that Rocketdyne would be the production supplier of an operational design. With further changes also in an operational IRBM to be put into production, Chrysler Corp. probably will be the prime contractor.

Advance Data

ARMSTRONG WELLS had looked before the McElroy decision from a source close to the IRBM situation that both Thor and Jupiter might be produced but that an operational target date in 1958 would be set.

This timing is considered for beyond that necessary to provide U. S. forces overseas with an effective IRBM capability, if these alone were given the full go-ahead signal now.

Quantity of missiles that would roll off production line of both Thor and Jupiter was put into production would be for more than needed to fulfill the operational deployment requirements at IRBM bases.

Selection of both Thor and Jupiter

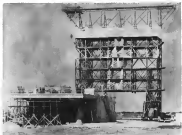
will add other complications. Critical ground support equipment items which will be common to both systems will pose serious problem of availability. Allocating this equipment to both systems will speed if too this, delay operational capability of each system.

Use of both Thor and Jupiter missile launchers systems also will increase complete overall logistic support problems.

While no service will reveal its true belief, estimate of experts close to the overall ballistic missile picture at that Army with its Jupiter is 12-15 months

before Thor is able to put a mass producible, operational IRBM weapon system into the field, concerning all the considerations of missile manufacture and evolution of the various support elements which will have to be operated by service personnel.

Need for a large number of operational IRBMs is seen not only to counter the immediate Russian IRBM threat but also when IRBMs become operational and are placed on pads both in U. S. and U. S. S. R. In the hands of our allies, these would form of IRBM launching sites would force U. S. S. R. and present a large number



THOR launching pad and partly crew at Patrick AFB, Fla. Storage facilities for liquid oxygen are located in concrete bunkers near track.

of targets and Russian would have to interdict, making an offensive option as part as extremely difficult task, without ensuring that all of the weapons through noninterference IRBM's.

Threats after that required to build an integrated operational weapon system such as the Thor IRBM is evident from the fact that more than 100 tons of more equipment for ground support are involved. Some of this equipment has as much as 3,000 components. One of the prime tasks in identification of all functions, consistent with the development of the missile. This is known as Qualitative Personnel Requirement data. It specifies what jobs must be done and what skill levels are required.

As far as to do more jobs in parallel with skills now present in the Air Force Structure.

Equipment design are carefully selected to reduce number of people and skill levels involved in operation. Equipment which is designed to have a high degree of reliability and a high degree of checkout equipment is reduced use of an additional highly skilled man, this function being immediately apparent in the light of present and

the Requirement for this man was diminished and the contractor directed to secure the job to another station where the skilled operator does could take over it.

Magnitude of the equipment development problem and development of associated skill requirements is evident from the following list items which represent a small part of equipment involved:

- Fueling facilities
- Liquid support devices
- Launching platforms
- Slings and deft.
- Electrical deft.
- Checkout equipment
- Countdown housings
- Towers to determine efficiency of missile squadding personnel

• Turbines
- Extensive training base for IRBM guidance, now under construction at Goddard Air Force Base, Calif., who will have operational capability, probably all sorts as a model for unmanned sites.

Ballistic Missile Division also working on world-wide logistics problem to insure fast support.

Classified Report Says Soviets Can Neutralize SAC by 1960

By Claude Witte

Washington—What must and will capabilities of Russian military capabilities. One of the prime tasks in identification of all functions, consistent with the development of the missile. This is known as Qualitative Personnel Requirement data. It specifies what jobs must be done and what skill levels are required.

As far as to do more jobs in parallel with skills now present in the Air Force Structure.

Equipment design are carefully selected to reduce number of people and skill levels involved in operation. Equipment which is designed to have a high degree of reliability and a high degree of checkout equipment is reduced use of an additional highly skilled man, this function being immediately apparent in the light of present and

the Requirement for this man was diminished and the contractor directed to secure the job to another station where the skilled operator does could take over it.

Magnitude of the equipment development problem and development of associated skill requirements is evident from the following list items which represent a small part of equipment involved:

soon after SAC have been recommended for top priority, the antiradical capabilities once a defense against an ICBM becomes possible (AW Oct. 14, p. 37).

Another observation of the Center report is that the U. S. defense budget must be based according to provide antiradical support in the interval before we can attack the Russian missile advantage. In addition to what has been said, the report says SAC must carry out its defense program to wait for the potential target.

How to Meet Challenge

While the Administration refused to acknowledge the gravity of the report's outlook, at least one USAF official admitted steps that can be taken to meet the challenge.

Col. Clarence S. Innes, deputy chief of staff for nuclear, emphasized in a speech to the National Defense Transportation Assn. that both nuclear attack and missile must be included in USAF's core strategy.

As we sit today, there," the General said, "the world faces tonight is correct because we cannot sacrifice clearly general means for missile support plan."

"We know that missile launchers can destroy strategic targets with a high degree of accuracy and reliability. We also know that jamming interceptors can

bet potential attacks at the outer limits of our defense perimeter."

In addition, he said, there are some jobs that can be done better by manned aircraft. One of these is the task of stopping enemy bombers before they ever get off the runway.

In this connection, the General declared, post defense should be a last resort, a desperate threat to shoot down the attacks before he can drop his atomic weapons.

Manned Missiles

Gen Innes and the Air Force has much under way on the subject of manned ballistic missile and space platforms. One reference was clearly to Lockheed's Pilot Pipeer reconnaissance satellite program (AW Oct. 14, p. 38).

The manned ballistic missile is also being to be the hypersonic glide that being conducted by Bell Aircraft Corp. at Buffalo, N. Y. (AW March 15, p. 72).

Another observation of the Center report is that the U. S. defense budget must be based according to provide antiradical support in the interval before we can attack the Russian missile advantage. In addition to what has been said, the report says SAC must carry out its defense program to wait for the potential target.

In this connection, the report says that the Russian already have tested a rocket of 500,000 lbs thrust for use in a hypersonic glide bodies, and it is believed that the Soviets have a project for an advance of U. S. efforts.

Another observation of the Center report is that the U. S. defense budget must be based according to provide antiradical support in the interval before we can attack the Russian missile advantage. In addition to what has been said, the report says SAC must carry out its defense program to wait for the potential target.

While the Administration refused to acknowledge the gravity of the report's outlook, at least one USAF official admitted steps that can be taken to meet the challenge.

Col. Clarence S. Innes, deputy chief of staff for nuclear, emphasized in a speech to the National Defense Transportation Assn. that both nuclear attack and missile must be included in USAF's core strategy.

As we sit today, there," the General said, "the world faces tonight is correct because we cannot sacrifice clearly general means for missile support plan."

"We know that missile launchers can destroy strategic targets with a high degree of accuracy and reliability. We also know that jamming interceptors can

bet potential attacks at the outer limits of our defense perimeter."

In addition, he said, there are some jobs that can be done better by manned aircraft. One of these is the task of stopping enemy bombers before they ever get off the runway.

In this connection, the General declared, post defense should be a last resort, a desperate threat to shoot down the attacks before he can drop his atomic weapons.

Manned Missiles

Gen Innes and the Air Force has much under way on the subject of manned ballistic missile and space platforms. One reference was clearly to Lockheed's Pilot Pipeer reconnaissance satellite program (AW Oct. 14, p. 38).

The manned ballistic missile is also being to be the hypersonic glide that being conducted by Bell Aircraft Corp. at Buffalo, N. Y. (AW March 15, p. 72).

Another observation of the Center report is that the U. S. defense budget must be based according to provide antiradical support in the interval before we can attack the Russian missile advantage. In addition to what has been said, the report says SAC must carry out its defense program to wait for the potential target.

In this connection, the report says that the Russian already have tested a rocket of 500,000 lbs thrust for use in a hypersonic glide bodies, and it is believed that the Soviets have a project for an advance of U. S. efforts.

Another observation of the Center report is that the U. S. defense budget must be based according to provide antiradical support in the interval before we can attack the Russian missile advantage. In addition to what has been said, the report says SAC must carry out its defense program to wait for the potential target.

While the Administration refused to acknowledge the gravity of the report's outlook, at least one USAF official admitted steps that can be taken to meet the challenge.

Col. Clarence S. Innes, deputy chief of staff for nuclear, emphasized in a speech to the National Defense Transportation Assn. that both nuclear attack and missile must be included in USAF's core strategy.

As we sit today, there," the General said, "the world faces tonight is correct because we cannot sacrifice clearly general means for missile support plan."

"We know that missile launchers can destroy strategic targets with a high degree of accuracy and reliability. We also know that jamming interceptors can

Greater Role Urged for NATO Science

By J. S. Dato, Jr.

Washington—Western Europe's technical community will become effectively ostracized if NATO nations are not given cooperation in scientific for the development of large missiles and advanced weapon systems. This was the opinion of some leading U. S. and European scientists attending the Seventh General Assembly of the NATO Advanced Group for Aeronautical Research and Development last week.

European development scientists and experts, they say, must be given greater responsibilities concerning weapons and their work programs brought about of the technological team if the free world is to obtain the maximum benefit from their talent. In short, they told the meeting of free engineers can maintain high standards in weapons design as light aircraft fighters while space flight is becoming a reality.

The AGARD scientists told American, British, and the Russians and the U. S. go into space and the world is even more aware of the fact of the world behind Europe's technical community, they say, will be effectively neutralized if they are not taken into a close and mutually dependent partnership in the design of the powerplants, guidance systems, structures, etc., upon which rely, high speed flight depends.

Most of basic science continue to research and produce in Europe is in the past, a basic science in the development of new weapons and the U. S. with the experience to produce advanced hardware.

Joint Technical Capacity

The European desire to become an integral part of high speed and centrally space flight studies at a time when the U. S. is in a position to be working more closely than the USSR. Working the European and U. S. technical capabilities into a unified and productive effort is substantially a difficult task, the scientists stated. They will require the highest type of leadership from the highest level. But, they said, the security of such leadership would be tremendous and would increase the technical force available to the free world for work on free power projects by well over 50%.

European science in a collective body would be able to contribute significantly to projects that probably would be impossible both technically and economically for the separate nations. The life of the average citizen's missile and feeling of contributing to his own defense also would improve.

Gen. Nathan F. Twining, the key note speaker of the two-day meeting, pointed out that the U. S. had dominated Europe until after World War II. He said that the U. S. had dominated Europe until after World War II. He said that the U. S. had dominated Europe until after World War II.

Then, he said, it became necessary for this government to finance large basic research programs to make up for the information which no longer came from Europe's disrupted universities and institutes. This U. S. program, and its companion development work, has been inadequate because it has not kept the U. S. advancing technically at a greater rate than the Soviet Union. Gen. Twining acknowledged that the Soviet growth rate in basic science is greater than our own and that the NATO governments must make a larger part to make the technical capacity of the free world.

Word Available

Just what the part will be available from the legislative and executive branches of the U. S. government and NATO leaders.

The U. S. Administration agrees with scientists that AGARD continued and directed by Dr. Theodore von Karmán, has probably advanced the greatest degree of international scientific cooperation on aerial German aircraft. He said that the AGARD scientists have been and that AGARD will be in the past, a basic science in the development of new weapons and the U. S. with the experience to produce advanced hardware.

Joint Technical Capacity

The European desire to become an integral part of high speed and centrally space flight studies at a time when the U. S. is in a position to be working more closely than the USSR. Working the European and U. S. technical capabilities into a unified and productive effort is substantially a difficult task, the scientists stated. They will require the highest type of leadership from the highest level. But, they said, the security of such leadership would be tremendous and would increase the technical force available to the free world for work on free power projects by well over 50%.

European science in a collective body would be able to contribute significantly to projects that probably would be impossible both technically and economically for the separate nations. The life of the average citizen's missile and feeling of contributing to his own defense also would improve.

European science in a collective body would be able to contribute significantly to projects that probably would be impossible both technically and economically for the separate nations. The life of the average citizen's missile and feeling of contributing to his own defense also would improve.

European science in a collective body would be able to contribute significantly to projects that probably would be impossible both technically and economically for the separate nations. The life of the average citizen's missile and feeling of contributing to his own defense also would improve.

European science in a collective body would be able to contribute significantly to projects that probably would be impossible both technically and economically for the separate nations. The life of the average citizen's missile and feeling of contributing to his own defense also would improve.

European science in a collective body would be able to contribute significantly to projects that probably would be impossible both technically and economically for the separate nations. The life of the average citizen's missile and feeling of contributing to his own defense also would improve.

European science in a collective body would be able to contribute significantly to projects that probably would be impossible both technically and economically for the separate nations. The life of the average citizen's missile and feeling of contributing to his own defense also would improve.

was held at the AGARD meeting on "Toward Higher Altitude."

In one of the preliminary papers delivered at the meeting, Dr. Theodor von Karmán, director of the Max Planck Institute for Physics at the Struthofsee and the Josephine in London, Germany, Dornberger reported that his research group believed they have been able to produce one of the Russian satellites at a maximum distance of 3,500 mi. for a period of two months with long wave length, wide band, back scatter radar equipment they normally use for studying the upper atmosphere. This equipment differs from aerial radar in that it has a wave length of about 10 cm instead of a few centimeters. It is used to affect signals off the upper atmosphere and back down to earth. At the same time, the earth, in other words, a weak portion of it returns to the radar set along the ground path, bouncing off the upper atmosphere again.

The method can be used to tell much about the selective qualities of the various layers of the upper atmosphere and their composition.

Word Available

Just what the part will be available from the legislative and executive branches of the U. S. government and NATO leaders.

The U. S. Administration agrees with scientists that AGARD continued and directed by Dr. Theodore von Karmán, has probably advanced the greatest degree of international scientific cooperation on aerial German aircraft. He said that the AGARD scientists have been and that AGARD will be in the past, a basic science in the development of new weapons and the U. S. with the experience to produce advanced hardware.

Joint Technical Capacity

The European desire to become an integral part of high speed and centrally space flight studies at a time when the U. S. is in a position to be working more closely than the USSR. Working the European and U. S. technical capabilities into a unified and productive effort is substantially a difficult task, the scientists stated. They will require the highest type of leadership from the highest level. But, they said, the security of such leadership would be tremendous and would increase the technical force available to the free world for work on free power projects by well over 50%.

European science in a collective body would be able to contribute significantly to projects that probably would be impossible both technically and economically for the separate nations. The life of the average citizen's missile and feeling of contributing to his own defense also would improve.

European science in a collective body would be able to contribute significantly to projects that probably would be impossible both technically and economically for the separate nations. The life of the average citizen's missile and feeling of contributing to his own defense also would improve.

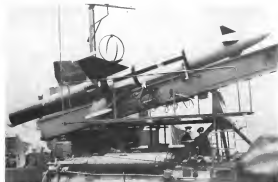
European science in a collective body would be able to contribute significantly to projects that probably would be impossible both technically and economically for the separate nations. The life of the average citizen's missile and feeling of contributing to his own defense also would improve.

European science in a collective body would be able to contribute significantly to projects that probably would be impossible both technically and economically for the separate nations. The life of the average citizen's missile and feeling of contributing to his own defense also would improve.

European science in a collective body would be able to contribute significantly to projects that probably would be impossible both technically and economically for the separate nations. The life of the average citizen's missile and feeling of contributing to his own defense also would improve.



DR. THEODORE VON KARMAN



Swedes Develop Naval Missile

Swedish Type 315 missile, designed for use as a surface-to-surface weapon against other vessels, is displayed aboard Swedish destroyer *Stordalen*. A development of the experimental Type 319 missile first fired in 1946, the 315 is controlled by two booster rockets, and carries an unexpended type of jet engine. The 315 prototype was first fired in 1951 and the complete missile in 1956. Test firings here before phase of Kirkling.

menters and Air Force have concentrated in their high speed, high altitude research programs with existing rocket planes.

The X-2, which had the greatest performance potential of any of the manned rocket planes yet used in the program, was barely a 10 year old design when it first flew. While it is a tribute to the Bell and NACA engineers responsible for its design that this plane handled high and fast, than any other piloted vehicle, the X-2 had many serious problems because it was ahead of its time and much of the design data was somewhat sketchy.

Kirchhoff was selected to pilot the X-2 during the high-altitude portion of its flight program after Col. Paul G. Tibbets had made the first seven flights in the aircraft and reached a speed of 1,550 mph.

Training for X-2

Four altitude flights were made, building up progressively from 45,000 ft. to 126,200 ft. Kirchhoff's training began before Tibbets' first flight and continued through his own second altitude flight. The training program was altered on the basis of information

passed from each flight of the vehicle. The most important part of this training according to Kirchhoff was a simulator and in connection with a CEDA training computer. The essential training demands of the X-2 were studied on the basis of flight test experience and the pilots were able to "fly" the aircraft many times on the ground to determine the feasible, safe and suitable conditions.

Flight Accident

X-2's altitude and instrumented problems are described by Kirchhoff in a detailed account of his flight to 126,000 ft.

Upon release from the mother ship, he found the rocket and because of limited longitudinal control, had to start his rotation to the climb angle of 45 degrees immediately. He pulled the stick full back and held it there until he had essentially flown out of his air atmosphere and re-entered again.

Just before his parachute started out at about 90,000 ft. a small re-entrant thrust developed and the aircraft banked to the left through a large angle. The simulator studies had shown that very large bank angles

should be corrected outward, at high altitudes to avoid a spin, but very difficult to control, slowing motion.

Seven roll couplings also could be expected through use of the rocket. Tibbets, Kirchhoff rode the X-2 through its unorthodox path to a point beyond 90% of the earth's atmosphere, back down to dense air and recovered at about 40,000 ft., all without moving the controls after his pulling the stick full back. He passed through the peak of his trajectory and re-entry phase in a severe wing down attack.

The X-2 flight altitude was called for by the most part Kirchhoff said. The aircraft went uncontrolled about 12,000 ft. low during the climb, so he was loaded by radar from the ground and his altitude reduced to 5,000 ft. Tibbets said the attitude gyro did not function properly, so the ground crew used a ground pencil to mark a line on the glass canopy which would be horizontal when he was at the 45 degree climb angle. Even though he had little if any control over this climb angle, the line would indicate whether the climb had stabilized near the desired angle.

Teller, Doolittle, Bush Ask More Defense

By Evert Clark

Washington—U. S. need strengthens its military position immediately, put much greater emphasis on research and science in general and make use of government in its educational system if it is to survive the rapidly growing threat of Russian missiles, satellites and political subversion, the Senate Foreign Relations Committee now warned last week.

All this will take more money and means longer hours and harder work for the nation, scientists said.

Comments were from the committee's members and critics scientific progress told the subcommittee that Russia already leads the U. S. in a number of areas of science and technology, is gaining rapidly in most others and threatens seriously to surpass the nation in all fields because her rate of progress is greater than ours.

Test witnesses were Dr. Edward Teller, Dr. Vannevar Bush, Dr. H. Doolittle, Dr. John Chapman and Dr. John P. Hagen.

Teller is associate director of the University of California Radiation Laboratory and a leader in development of thermonuclear weapons. Bush is chairman of the Board of Massachusetts Institute of Technology and wartime director of the Office of Scientific Research and Development. Doolittle is chairman of the National Academy of Sciences and Bush is director of the Air Force Scientific Advisory Board. Chapman is chairman of MIT's metallurgy department and Hagen is director of Project Vanguard.

What's Needed

Teller, Bush and Doolittle were generally in agreement on what steps needed to be taken immediately to begin meeting the Russian challenge.

• **Provide more money** wherever needed to strengthen present defense—particularly Strategic Air Command, missiles and submersible nuclear attack—efforts and to spur research and development. Doolittle said the nation's defense "cells for an immediate and substantial increase in our military budget. All these measures that money is not the sole answer but all applied work of kinds has done here in the recent past, especially in basic research.

• **Improve organization** of the defense structure—but gradually, so that it is not set back in the process. "We are now in the position that we have to go on. We cannot stop and create the ideal situation," Bush said. All three called for greater decisions making and clearer lines of

responsibility but they were inclined to think it could and should be done quickly through existing offices.

Bush said he was not planning ahead to do what he and the Joint Chiefs of Staff have not been able to do—make unified war plans. He and the Joint Chiefs, who also announced their respective views, agreed and he has not made any decisions which must be made and have not been unanimous on others.

Doolittle suggested a staff of "young, aggressive" military officers to the Secretary of Defense who would be individuals free from loyalty to a particular service and would serve approximately the same function as the Joint Chiefs suggested. Bush and the three might be better advised than those they advised.

Doolittle said the country must be headed toward "a single center with one mind," although he is not ready to advocate it now, and issued a general staff. Bush specifically opposed a single center but urged the administration to "overhaul the National Defense Act, which has never worked," and eliminate "disorganizing" interagency rivalry. Doolittle said fear of the general staff concept was unwarranted.

• **Widely acquire scientific and technological aspects of education**, the three agreed, as the driving reason for Russia's great gain. This would include more classrooms, more and better teacher training, more and better work by students and gradually, perhaps, to both teachers and students. All three said this is the heart of the solution of the language problem. Bush called the situation in education a "crisis."

• **Greatly increase the prestige of science and scientists.** Teller said some Russian scientists travel 10 times as much as a Russian day laborer. In the U. S., more do not make as much, he said.



DR. EDWARD TELLER

said. Bush said the U. S. has generally had "a great disregard for scientists" and his teachers "left them to their own devices. I hope it will be no more so," Bush said.

In varying degrees, all three advocated less secrecy. Bush said the country has "probably at many points in time as in keep secret" now and "is more emphatic on that sort of thing in the future."

Charmus London Johnson (D-Tex.) said the subcommittee hopes to get a clear picture of the threat to U. S. security. He called it "perhaps the greatest fear of our country has never known." No witness has disputed him. Hagen was attracted by a number of members of the panel Senate Armed Services Committee, but a large conference.

Dr. Hagen said the U. S. scientific leadership efforts, called for a single agency, possibly within the Defense Department, to direct all scientific and space step programs. This must be done if it is to have any chance here in the area, and it must have full power to set policies and "the responsibility and authority to act." It should encompass "further space investigation and flight" including studies on manned satellites.

Both Teller and Doolittle urged research and development aimed at space flight. This also requires "a sound educational program," Doolittle said. Congress, he said, must do that. Sputnik has made the scientific problem the space program a particularly acute one.

Improve Education

Dr. Chapman, who turned two Russian steel plants and three metallurgical societies in Russia last summer, urged spending two or three times as much on basic research as the U. S. now spends and strongly advised all groups to steps to improve education.

Russian new graduates 4,500 metallurgists a year to 600 in the U. S., and he has been in many metallurgical works, for decades in the U. S., he said. Of the 4,500, some 900 are more experienced than the total number graduated in the U. S. Training is good there are four or five applicants for every position, and students get a graduate stipend instead of paying tuition.

He said that when it comes to research and development and training and the new one is "as good as" in the U. S., Dr. Chapman said. Russia is "more rich in good" in better producing techniques in this country, he said.

In addition to larger steps, the witnesses recommended:

- **Teller** immediate strengthening of



Shock Wave Forms on Diving Regulus I

Shock waves building ahead of a Regulus I missile at approach speed in a tunnel due to caught in unusual photographic films in the South Clay Island detached shock wave can be seen first light from down-looking camera system. Atmospheric conditions make it possible to photograph the shock waves, usually only visible in laboratory photographic films in wind tunnels. Shape of wave indicates the missile was traveling at Mach 1.1. Picture was taken through a 68 in. F7 reflector telescope lens at a distance of 1.9 mi.

SAC is adding plans and crew and changing hours and phases. Doublets, existing in quantity by Sea Star (Seawing) (D) Miss, aged around B 32 products and called the B 38, which all estimates B 52 in SAC-shock.

Teller also recommended some money for nuclear-powered missile submarines and greater emphasis on private defense—possibly including a "shutter program" to protect against fallout and firestorms, dispersed supplies of food, machine tools, tools, etc., so Russia could never completely cripple the nation, even with its offset attack. This is an important part of the deterrent concept, he said. He suggested determining more thoroughly and completely what nuclear attack and how it would not kill some missile programs. Rather, he would select some for retention, and use others for research and development. Asked about efforts to replace atomic and nuclear aircraft propulsion, Teller said he has been a member of Atomic Energy Commission's General Advisory Committee for about a year and, although he believes there must be development of these two programs, "in my private opinion... I am in favor of general work which has been done."

•Rudy Eusepius was chairman of a board study program. "The way of the future can be so much what we think it will be," he said. He urged

careful study of the chemical and biological warfare threat.

•Doelittle, almost silent on an anti-missile missile and the comprehensive missile-detecting radar is needed now. He also urged immediate work on radar detection, including coverage of the air area of the detection network, an improvement of Air Defense Command and Tactical Air Command aircraft and increased effort for the Army. He also said he must maintain a sound crew size and a high standard to withstand a cold war that may last "five, ten, 20, 30 or 100 years." Doelittle met Maj. Gen. Bernard Schriever, commander of USAF's Ballistic Missile Division, told him a week before that the intercontinental ballistic missile program had enough funds for present, but there would be "years where they come up against shortages and he would need help then." Doelittle said progress on an intercontinental missile program would be faster if all the people working on USAF's Thor and Atlas's Jupiter were brought together. He said "leaves" but that a decision will be made by Jan. 1 as to which will become an operational weapon.

Embracing the "hotter economy," Doelittle said contractors estimate that Russia puts 25% of its gross national product into the U.S. puts 5.5%.

In 1947, Russia's industrial base was one seventh of ours. Now it is about

one-third, and "improving" twice as fast, he said. Russia's gross national product rose at about one-third of ours and increasing half again as fast.

Russian students finish high school in 10 years or less (7), and have 12 hours study weeks. Doelittle said Air high school graduates have studied algebra, geometry, trigonometry versus 14% of U.S. students, and they also have had calculus. All have five years of physics. Here, 35% take one year of physics. All take four years of chemistry. Here, one third study one year of chemistry.

Doelittle and Soviet Russia has a double advantage, better for all the people, which he would not advocate for the U.S.—not as revealed if you do will or destroyed if you don't.

Engine Icing Fixes Tested on Britannia

London-Bristol Airplane Co. has sent a long range Britannia 312 to Singapore, to try out engine related new non-conditional two types of modification in the wing-fuselage Pegasus 755 engines.

Outboard power plants are equipped with a device for tapping air from the engine compressor and re-energizing it through a number of small nozzles in the engine intake duct.

Inboard engines have the second

modification now being tested.

Fourteen technicians were aboard the Britannia, as well as two American technicians. Overseas Airways Corp. Britain's chief pilot, Walter Glick, is pilot, captain.

If the Singapore trials and other possible flights are successful, BACV expects to start non-stop transoceanic passenger flights with the Britannia in Dec. 1953.

Both de-icing techniques in the Britannia at Singapore showed good results on ground rigs at Farnborough.

In the two outboard engines, small ice masses—25 at three-inch fitted to the outer wall of the intake duct. These do not get of air along the inner surface of the rear wall of the intake in order to re-energize the boundary layer and in general not re-energizing on the surface.

Speed about 500 mph, the air jet nozzles are supplied by means of a ramjet operating the intake. Air is taken to the intake from the intake air pressure tapping taken from the fuel delivery stage of the engine compressor.

Amount of air tapped from the compressor is approximately one-half 10 sec. When this is in operation it causes a slight loss of power and a small increase in specific fuel consumption.

In terms of aircraft performance, this would mean a cruising altitude about 1,500 ft. lower and a 2% loss of range. If the intake was in operation all the time, but normally, based on such a small proportion of air, flight would

be carried out under these conditions.

The air intake engine will have increased loss applied to the walls of the air intake duct which will now be heated in gas at 180,000 instead of the standard 150C. The hot gas is fed to the rear of the curved wall of the air intake at the head of the intake air jet the engine compressor.

Based on this also has improved the delivery of the hot gas.

News Digest

North American Aviation's Catalyst

North American Aviation's Catalyst is producing aluminum will provide for commercial loading applications. The company has five contracts totaling approximately 5,000,000 and is forecasting market will for commercial buildings in Hollywood, Calif., New York City and the Chicago area. Catalyst often compares loading, cutting and forming operations on aluminum sheet and aluminum extrusions, comparable production of them steel ones, and availability of parts into complete custom job parts.

Chance Vought's F3U-1 Corsair will begin regular sea duty for the first time next year. The aircraft will be operational with Navy Fighter Squadron VF-12, which will go aboard the USS Saratoga in the Atlantic. Shorthair VF-12 departs, B-50-1A, will go

aboard the USS Hancock in the Pacific with Fighter Squadron 154.

Kennedy Aircraft Corp. will produce H-43A and H-43B multi-engine helicopter for USAF. Multi-engine helicopter calls for initial deliveries of H-43A (powered by Pratt & Whitney T53-11A piston engines) later deliveries of H-43B powered by Licensing T55 gas turbines.

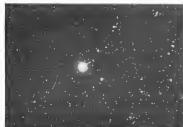
Hamilton Aircraft, government-owned factory in Burlington, South Dakota, will produce an advanced version of the Bristol Optimist 2 (aircraft) (AW No. 25 p. 31), according to Hamilton Aircraft engineers. The engines will be produced on a large scale before 1953 in private Hamilton Aircraft's full production jet fighter, expected to fly in 1953, the engines and "The fighter is currently producing Pegasus Gas Engines."

Solar Aircraft Co. reports also had not income in the six months ending Oct. 31, exceeded that of the comparable last six months of the preceding fiscal year. Sales in the first half of 1953 were \$41,728,100, compared to \$14,137,580 for the same period last year. Net income for the first six months of fiscal 1953 was \$1,616,400, compared to a loss of \$199,800 in the first six months of fiscal 1952. Earnings at Oct. 31 was \$64,418,905, compared to \$92,945,000 last year.



Gannet Modified for Training

Trainer version of the Fanny Gannet amphibious aircraft, designated the T, M, S, has been developed for the British Royal Navy. Modification is in the second set, but has the help of a prototype for visibility. Powerplant is Armstrong Siddeley Double Mustang turboprop.



EXPLOSION of shaped charges was photographed with Stiles Super-Schmidt motion camera at Sacramento Peak Observatory in New Mexico. Pellet took on its form at upper right of the explosion. Camera is pointed almost directly towards the south.

USAF Launches Artificial Meteors

Bedford, Mass.—Artificial meteors were launched from an Arched rocket rocket 54 miles over New Mexico, Air Force Cambridge Research Center as called last week. The meteors were aluminum pellets blasted to a speed of 31,000 mph by means of shaped explosive charges placed in the nose of the rocket.

At least two of the aluminum pellets are presumed to have maintained sufficient velocity to escape from the earth's grasp. Escape velocity is about 25,000 mph. The experiment will be used to obtain information on density, winds and temperature of the solar atmosphere.

Research Program

Launching of the pellets is a part of the research program of the Cambridge Research Directorate of AFMCC and



NOSE of Arched rocket showing mounting of three shaped charges.

was under the direction of Maurice Dabbs. Fabrication of the charges and setting up of the rocket was done by Professor F. Zwicky of the California Institute of Technology and Dr. T. C. Poulter and M. C. Wells of the Stanford Research Institute.

Launching was from the Air Force's Arched launching tower in New Mexico. When the rocket reached an altitude of 54 mi, the nose action containing three shaped charges was triggered from the instrumented part of the rocket to produce the instruments from the blast.

The nose section erupted to an altitude of 54 mi where the charges were detonated. The blast was very bright, having an intensity approaching -10 visual magnitude.

It was observed at Mount Palomar observatory about 600 mi away with a brightness greater than any other object in the sky.

Pellets Photographed

One of the pellets was photographed after the explosion. Its brightness was about -2 visual magnitude which is about as bright as Venus.

Other attempts have been made to fire artificial meteorites beginning in 1947 with V-2 rockets but this is the first successful meteorite launching. Scientists at AFMCC are confident that such meteorites will be a very powerful tool for research into the physics of the upper atmosphere.

Using of the artificial meteorites may also supply data useful in solving the recurrent problem of long range ballistic missiles.

Technique Converts Heat to Electricity

New York—Technique for direct conversion of heat into electricity, which might find application in missiles and high speed aircraft, was revealed last week by General Electric's research laboratories.

New thermionic converter, now in the laboratory stage, has conversion efficiency of about 35% but a figure of more than 50% appears possible, General Electric says. By comparison, conversion efficiency of a modern steam turbine generator is around 40%.

Conversion efficiency of new device is roughly comparable to that obtainable with semiconductors and considerably higher than that obtainable using conventional thermocouples.

Conversion is accomplished by means of device which resembles a gas filled diode. When one of the electrodes, called the cathode or emitter, is heated to temperature of around 1,000°F, electrons lead off its surface and travel at high speed to the second electrode, called anode or collector.

Current then flows from the anode through an external load and back to the hot emitter resulting in a gas filled diode. When one of the electrodes, called the cathode or emitter, is heated to temperature of around 1,000°F, electrons lead off its surface and travel at high speed to the second electrode, called anode or collector.

General Electric's thermionic converter basically is a low-voltage source, producing about .55 v.d.c. under open-circuit conditions. Individual cells can be cascaded to produce higher voltages. Laboratory model has produced approximately 14 amp per sq. cm. of cathode area, according to E. Wilson, but he hopes to raise the current density to approximately 10 amp/sq. cm.



GE's thermionic converter



THE CONVAIR JET 880 WILL OFFER YOU COMPLETE LUXURY...

Two on the Aisle!

Luxuries in every detail, the Convair Jet 880 will offer travelers in the new jet age first-class two-above seating throughout! In addition to unmatched luxury, the 880, with a cruising speed of 615 miles per hour, will be the world's fastest jet passenger plane!

CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION



Spawt

Flag-raising day at another great new Olin Aluminum plant

Graded in the heart of the Ohio River Valley, this expansive industrial plant is about to spring to life.

With modern from the ground up, this high new Olin Aluminum Sheet Mill within a few short months will add its production to the enormous nationwide at quality Aluminum flowing to the nation from four Olin Aluminum plants.

Flag-raising day at this great new mill will mark an important new chapter in the exciting 20+ year growth of Olin Aluminum. New ore ships, rolling mills, extrusion plants and wire and cable mills are already in operation or under construction. With these modern, fully integrated facilities, Olin Aluminum is right now on the way to an initial annual volume of 300 million pounds of quality Aluminum. And that is only the beginning.

This new Aluminum will be custom-tailored to your specifications. And the unique standards of quality and service by which it will be produced and delivered to you will help you simplify your manufacturing procedures and achieve maximum efficient production from each pound you use.

If this is the kind of quality and service you have long been looking for, write now for product specifications to our new permanent sales headquarters: Aluminum Division—Sales, Olin & Matheson Chemical Corporation, 680 Park Avenue, New York 22, New York.

OLIN
ALUMINUM

Symbol of new Standards of Quality and Service in the Aluminum Industry



© 1961 Olin & Matheson Chemical Corporation

New Titanium alloys

developed by Mallory-Sharon for the missile age

Two remarkable titanium alloys developed by Mallory-Sharon's Research Laboratory have entered the marketplace in the metal in hot environments. The development process, more and more applications in rockets and missiles for titanium—strongest metal per pound of weight in its temperature range.

Commercial introduction of these new alloys estimates research and development over a two year period. In the intensive evolution of both laboratory and production steps, thousands of individual tests were made and analyzed. The results:

The first new alloy (MST 801) is a weldable sheet and bar material which offers strengths equivalent to similar titanium alloys—at temperatures two hundred degrees higher. This exceptional advantage is maintained in the range of 400 to 2000 degrees F.

The second new alloy (MST 23A1-3BV) offers remarkable ease of fabrication for a high strength material. Sheet metal parts can be readily formed while the alloy is relatively soft, then can be heat-treated to high strengths. Heat treatment more than triples the strength level of this alloy.

As titanium's future in our air defense grows, it is likewise proving a tremendous advantage in new industrial applications. Let Mallory-Sharon, technical leader in titanium, help you design ahead with this new metal.

MALLORY SHARON

MALLORY-SHARON TITANIUM CORPORATION • 11115 DAVIS



Products of titanium and titanium alloy sheet, strip, plate, rod, bar, billets

AIR TRANSPORT

Airlines Press for Financial Stature

Carriers tell CAB of difficulty in finding money for new equipment as fare increase hearings continue.

By Fred Eastman

Washington—Hearings in the General Passenger Fare Investigation came into their third week today as airline officials and financial experts continue efforts to prove that desirable airlines are poor competitors in the money market.

Largest portion of the case up to now has been taken up by American Airlines whose witnesses have been laying the groundwork for the carrier's contention that fares must be increased if they are to meet these obligations to the public and investors.

Airlines will take the stand in alphabetical order during the next two or three weeks, each presenting a statement attacking the problem of competing in the money market from different angles. All 12 domestic airlines in addition to the Air Transport Association will have an opportunity to be heard.

Rate of Return Study

The hearings have been divided into three sections—consideration of rates of return, financial aid and capital expansion in the future and conclusions embodying other remaining issues.

Purpose of the testimony now being presented in the rate of return study is to prove to the satisfaction of the Civil Aeronautics Board that the financial standing of airlines is not strong enough to raise the issue of money necessary to meet rate the rate of return.

Major witness advanced by the industry for airline's poor financial standing are:

- Earnings have been spent and even in the best years have not been sufficient to compensate for the bad years. Per capita, earnings are being spent up to a point where management is borrowing money in the new future.
- Rate of return on investment and the operating profit margin are too narrow for an industry with the constant characteristics of the air transportation industry.
- Present airline fares are not high enough to permit earnings that will result in a fair and reasonable rate of return or a safe margin of profit.

Airlines differ on the rate of return necessary for each individual company but generally agree it should be in excess of 12%. American Airlines set the rate of return at 12%, a profit

margin of no less than 7%, and to prove that goal, witnesses testified that fares would have to be increased by 15%.

Tyroid of the difficulties facing airlines is American Airlines' own problem in completing its financing program. Its witnesses said American Airlines needed \$10 billion more to complete the first phase of its transition to turbine aircraft. To finance this, the company borrowed \$157.5 million without too much difficulty. However, to go into the second phase and buy 15 additional long range jets and 25 intermediate stage planes an additional \$100 million will be required. It estimated that \$100 million would be needed from outside sources.

At the time the financing was arranged for the first phase, the company assumed that its earnings would fall below the \$18,620 million level for any year through 1960. These earnings, it said, would permit the equity base to increase so that during the past period in 1959 the debt would be reduced. However, he said, Commodity prices and other factors in line.

Earnings Trend

Under these conditions, American felt it could not raise its stock in the open market. In fact, because its equity base has fallen by so much, approximately \$30 million in cash. Thus, through the increased equity, the company felt it could borrow \$75 million to reach the \$100 million total.

Petition Denied

Washington—Petition of five domestic airlines to review existing regulations filed in the General Passenger Fare Increase Case have been denied by the Civil Aeronautics Board. The airlines had applied for fare increases according to 60% which the CAB had turned down last September. The CAB and its action does not affect the pending General Passenger Fare Investigation which is currently under way before a CAB committee and covers the entire domestic airline fare level.

Airlines asking for reconsideration in the General Passenger Fare Increase Case were Capital, Trans World, United, American and North-west.

without exceeding the debt-equity ratio.

New American said, the Government's new earnings test completely changed the picture. The market value of stock has dropped and the equity base will not increase the proportion required. Therefore, even without additional borrowing, the debt-equity ratio will be too high to raise an additional issue through borrowing. Also, the money that could be raised through equity financing will be greatly reduced.

Financial experts told the CAB that companies' position are connected primarily with what they will receive in return for the use of their funds. If a company's earnings are not sufficient to return a fair portion and still pay out dividends, then the investor is likely to be one that will.

The rule that profits play in a private enterprise economy was outlined by one of American's last witnesses, W. H. Hollman, American Airlines' assistant vice president for economic affairs.

Earnings Study

High and stable profits which greatly exceed normal levels for expenses also are a necessary condition for growing and sustained earnings. American Airlines' low and unstable profits reduce the flow of funds for interest financing and discourage external financing.

Hollman introduced a comparison study of the earnings records of 157 companies which American said compete with in the financial circles for new capital. He said the study of the company's earnings records, where charted, showed that earnings of American Airlines fell in the group with low and unstable earnings.

American Airlines earnings, he said, place it in a group of industries, such as the tire and rubber industry and paper, which have been in a fairly stable position in the industry. He added that American's earnings have been subjected to more violent gyrations than all except the two heaviest industries—steel and automobile—and automobiles but that American is thus in a position where it is forced to take the risk of instability in an extremely high margin level of earnings.

Hollman said the margin level of the stability of airline earnings in that profit margin are extremely narrow in a time high-cost economy. American Airlines' present earnings are upward pressure on costs, or any delay in the rate of growth of

arrange, quickly, maximum savings rates that might be reasonable in a stable industry are less than are reasonable in an unstable one.

Nelson Lee Smith, American case president for consumers and the nation's fuel vendors, said new and imaginative approaches by the CAB to the problems facing the airline industry are imperative if the regulatory agency is to instill the studies which the industry itself is making as technological advances and public service.

Smith said that traditional approaches and methods developed in the fields of conventional public utility regulation are not applicable without substantial modification to the air transport industry, which resembles much more closely the unregulated world of business enterprise.

Regulated public utilities, as opposed to the airlines he testified, enjoy a much wider deferred position similar in the benefits of doing business and no fluctuations are concerned.

In contrast to the stability of the market for standard utilities—gas, electric and pipe line companies—action on the other hand must deal with questions who first decide whether or not to take a trip, then to which means of available transportation (air, motor car, train, private automobile or air) and finally which airline to take if the trip is by air.

Eastern Letter Gets CAB Warning

Washington—Eastern Air Lines was warned last week by the Civil Aeronautics Board that attempts to "over the Board's judgment" in pending cases by written and brought out an explicit warning will not be tolerated.

The Board said it issued the warning after receipt of a copy of a letter written by an Eastern vice president that, it said, appeared to be an attempt to influence a Board decision.

The letter, according to the Board, was written by Robert Ranspock, Eastern vice president in Washington, and directed to Brock & Co., a Minneapolis stockholder. It set forth the nature of Eastern's application in the Chicago-Milwaukee-Twin Cities case the Board said the benefits to be received from an award of the new route definitely sought and pointed out that hearings on this case had been concluded.

The Board and the letter specifically suggested that the recipient might wish to write to its congressional and state, or directly to the consumer committee of Eastern's actions, discussed earlier to the Board's principles of practice. The letter said it seemed that this letter constitutes part of a planned program to solicit Eastern's stockholders in an effort to effect support.

In a letter to E. V. Reinhardt

Eastern Board Chairman, CAB Chief was James D. O'Neil said.

"We recognize, of course, that all applicants before the Board have the right to request their stockholders and other interested persons with the facts and the merits of their applications and to the practice governing proceedings in which these applications are to be heard and acted upon."

However, in our judgment, activity of this sort with which we are here concerned is not a permissible one and goes beyond the bounds of propriety. It is to influence the administration of efforts by non-parties to sway the Board's judgment on the basis of non-record considerations."

CAB said that, in 1956, the Board directed a letter to Ranspock concerning Eastern employees circulating materials purportedly designed to elicit the assistance in pressuring the Board to change its decision in the Florida-Texas case and requested cessation.

"In one of the stated and repeated clauses of Eastern's actions discussed earlier to the Board's principles of practice," the letter read, "the Board believes that appropriate steps should be taken by Eastern's board of directors to guard against any further recurrence of similar incidents."



RECTANGULAR layout of Los Angeles International Airport plan (top) has concourse building in center, older buildings looking from left to existing buildings. Beyond on right are satellite looking buildings, connected underground to existing buildings (bottom).

Los Angeles Starts Jet Age Terminal

Los Angeles—Construction of a \$46 million jet-oriented passenger terminal at Los Angeles International Airport began this month and is expected to be completed in January, 1960 (AW Nov. 4, p. 45).

Work will be speeded to meet an increasing traffic load, and an enlargement of jet facilities. Present figure of 841 daily aircraft movements is expected to rise to 1,000 daily by the opening date.

New passenger terminal area, covering 265 acres, is expected to accommodate 9 million passengers in 1967 and 15 million in 1970, with provision for even further expansion. Lay out consists of a rectangular arrangement with satellite terminal buildings located around the perimeter operating as independent units.

One story below airfield level in the center of the rectangle are runways and a 40-acre parking area for 5,000 cars and an additional 2,400 auto parking spaces over present facilities.

The area is expanded by double decking.

Over the center of the rectangle, a restaurant and concourse building will be elevated to afford an overall view with open walkways to the parking area and terminal areas. Included in this center complex will be a main entrance and cocktail lounge, employee cafeteria, shops and services for the public. Final design of the restaurant complex awaits decision of the airport commission and city council.

Each satellite will have a ticketing building serving as a check-in point for passengers and baggage.

Large sign denoting the specific airline will direct passengers to check-in points.

Underground passages for passengers and baggage lead from the ticketing area to satellite buildings located at the aircraft loading area.

Each satellite serving as a public lobby and ticketing building point, will contain waiting areas, a restaurant and cocktail lounge, newsstand and other service facilities.

Schemes for separating ticketing and baggage operations (located in ticketing buildings) from lobby and passenger services (in satellite buildings) relieve

the congestion encountered in air terminals today.

Six satellite buildings are included in present plans, with provision for a seventh to handle domestic services. Each satellite has 70 plane landing positions, each able to accommodate jet transports. Elimination of a finger concourse through the use of satellites allows flexible layout arrangements of 360 deg around each landing area.

Each satellite has two floors covering 74,000 sq ft, which can be expanded 50% by adding a mezzanine. Each unit has a strict elevator, escalator and staircases.

Underground passages give passengers maximum protection from air craft noise and blast and weather. Passengers park but can underground unit directly point and remain at first lower level through ticketing and baggage operations. He walks through passageway into satellite, where he is brought to satellite lobby level via escalator for loading. Airplane walking distance from entrance forward to aircraft loading is one block.

At the airport entrance, a 150-ft con-



Production Moves Ahead for Boeing 707

First Boeing 707 production airplane (upper left) has approved workings done about halfway and the second and third airplanes are now in completion. Four airplanes, which will make its maiden flight this month, will be turned over to the Civil Aeronautics Administration (CAB) for certification tests. Next two, also destined for delivery to Pan American Airways later, will participate in these tests. All four are model 707-123 powered by Pratt & Whitney T37 (17) turbojets. Production line begins on the number seven airplane, the first of an order for 16 from American Airlines. First Pan American deliveries are scheduled for late 1959. American will get its first airplanes in 1958.



PASSENGER crowd leads into satellite building around which planes are parked on land at LAX. Corridor shows from interior to satellite building may handle baggage by end, from air conveyer belt.

fuel tower will also serve in an identifying radius. Upon stairs within the tower will reach seven floors for Civil Aeronautics Administration personnel and equipment.

Lower levels of the tower will be offices for the Los Angeles Department of Airports.

Concentric transportation around the entire complex is planned, using a low-cost transportation system to be reported by a consortium.

Estimated total replacement program will cost \$46 million, including \$57 million construction costs plus land acquisition, engineering and inspection fees.

Airport Plan

Construction schedule.

- **Construction** will be done in four phases. Phase I, involving \$1 million, will begin immediately and will include construction of new aircraft runway and taxiway and external service roads, relocation of department of airports general maintenance yard, and development of maintenance area for part as by satellite or center. Estimated cost will be \$625 ft. actually, with provision for lengthening to 10,000 ft.

- **Phase II** will begin about May, 1958. Cost of this phase is estimated at \$1,135,500, including grading of north and south spurs, excavation of center interchange, construction of underground parking and baggage channels, underground utilities, water and sewage treatment, drainage, reinforced concrete retaining walls, lengthening of existing north-south runway to 6,750 ft.

- **Phase III**, including approximately \$21,579,535, is scheduled for contract award in September, 1958, includes construction of trucking and satellite buildings, central area buildings, including main

restaurant and cocktail lounge and central tower. Construction will be completed in January, 1960.

- **Phase IV**, costing about \$7,260,788, is to be completed in February, 1958, and completed in December, 1958. This includes parking of aircraft, more parking area and external roads. Lighting for aircraft apron and streets also will be included.

More than 1,500 workers will be employed by contractors in the expansion program.

United Places Order For DC-8s, 707-720s

Washington—United Air Lines is ordering an additional 10 Douglas DC-8 long-range jet transports plus 21 of Boeing's aircraft, announced 707-720 maintenance job (AW Nov. 23, p. 45) for 1958 delivery. The order, marking the second phase of United's equipment program, will bring the airline's fleet up to 51 planes, including 30 DC-8s already on order for 1959 delivery, at a total cost of \$175 million.

Being run by the new four-engine 720 will be capable of cruise speeds above 650 mph, and will carry 100 to 125 passengers. It is to be powered by a new, lightweight version of the Pratt & Whitney JT4 commercial version of the J57, with a thrust of over 12,000 lb.

United said the 710 will have a maximum takeoff weight of 201,000 lb. and will require shorter airport runway lengths than the long-range 265,000 lb. DC-8. It is scheduled to be capable of operation into and out of air transport units, used by United's passenger jet DC-7C.

United President W. A. Patterson

said the 40 DC-8s will meet the airline's long-range requirements for the next several years. "As we introduce our plans for the equipment required to convert (effectively) to turbine aircraft," Patterson said, "these maintenance units will be added in the interim years to place out the increasing modernizing pattern required."

United said it expected the third jet shop will be an order for aircraft for its short-range segments. The order, it said, will be postponed until after the long and maintenance equipment program is well advanced.

The company announced financing for \$174 million in 1955 when it placed an original order for 10 DC-8s. Patterson said arrangements are being completed for an additional \$100 million in the form of bank credit from a group of banks headed by the First National City Bank of New York.

Continental Air Plan Offered by CAA

Washington—Civil Aeronautics Administration yesterday offered the continental aspect about 24,000 ft. is as traffic control service on its optional basis.

Previously, the CAA had offered traffic control service only on the 100,000 miles of designated federal airways and around major route terminals. Over the airways of the airport plans had to be carried on "no" and be accepted without assurance of acceptance.

Commercial airlines now submit for the 24,000 ft. or above altitude and will have little opportunity to take advantage of the CAA traffic control service until after the construction of jet airports. At present, the program will primarily benefit the substantial volume of military jet traffic already using the airports above 24,000 ft.

CAA pointed out that handling of the military traffic will give the agency an opportunity to gain operating experience and time to install some facilities and train the people required for the more comprehensive control program that will be needed when the commercial jets arrive.

Control of airports over 24,000 ft. is the first stage of a four-stage, long-range program. The next step will be the lowering of the floor of the continental control area to 15,000 ft., working levels now used by commercial jet transports. But work already is on an optional basis. This is expected to become effective by next spring.

CAA Administrator James T. Hyde said the CAA hopes to have the equipment and personnel required for the continental control of all airports by the end of the 1960s. By then, military jets are expected to be in operation

Rickenbacker Caustic on Fares, Wants 15% Stopgap Rise Now

New York—Airline industry leaders are a good short sale," members of the New York Society of Security Analysts were told by E. V. Rickenbacker, chairman of Eastern Air Lines. Rickenbacker called for an immediate meeting by Civil Aeronautics Board of a 15% fare increase in standard passenger fares pending the outcome of the General Passenger fare investigation.

The stopgap increase, he said, is one element in the Board's plan to bring our badly losing industry back on an even keel with power enough to meet ahead.

Deteriorating Position

Otherwise, the Eastern chairman warned, it will take at least a year for the "situation procedure" to be completed and no one can tell what point the airlines will be in by then. He suggested that "every year since 1955 might be required to restore the carriers to health if present conditions are not taken to get reversed."

Regarding the pace of the hearings,

Rickenbacker asserted that "at the rate they're going, there won't be more of us left" by the time the hearings are loaded down.

An enormous mass of facts is being filed with the Board, he said, "which undoubtedly, some of them will over come."

After all the "bail and burlap" of a year's hearings, Rickenbacker said, the Board could arrive at no better solution than the one that is available to it today—i. e., to grant the 15% increase.

Unthinkable Alternatives

The Eastern official expressed his confidence that the board will approve the increase as passenger and cargo traffic. He said the "obvious unthinkable" alternatives were:

- **Cutbacks** in order for any aircraft to be able to carry less of a load in these areas who have made down payments and would "fail a critical test to accept noncommercial who, at this very time, are faced with increasing passenger pressure to force them to do with and instead of our

country." It would also argue the job by, demands affect the actual industry and commerce, give something within a competitive edge and impede the airline's contribution to national defense.

- **Tripping of the public** means to put the airlines back on subsidy. Capital Airlines request for subsidy may well be followed by others if effect is not forthcoming, but enough. The bill would require a minimum of \$150 million a year "just to start with."

- **Reduced operations.** This would mean a cutback of 20% of the services now available to the public. Rickenbacker also suggested that airlines might suffer through increased operating and maintenance standards. "Under it is unworkable," he said, "that any action—or lack of action—by any governmental department could force upon the industry any such desperate situation that would jeopardize the public safety."

The stopgap increase, Rickenbacker said, would do more than anything else available to the industry to help the airlines survive financially. Now, it would help restore investor confidence in the industry.

- **In reply to other questions** by the press, he said:
- **There will always be a market for**



East Germany's Jet Transport

East Germany's modern jet transport, reportedly designated the Messerschmitt B 112 (AW Nov. 4, p. 41), is depicted in this drawing. The 4070 passenger aircraft, conceived, developed and under construction by the East Germans, is expected to be completed next May. It will reach a 300 mph, have a 1,940 mi. range, and its four jet engines will develop more than 27,000 lb. total thrust. Designers say the plane will be capable of achieving a takeoff run of only 7,500 ft. with a full load. Similar planes require about 4,000 ft.

New School Expected to Enhance American's Bid for Stewardesses

By Craig Lewis

FL. Worth—American Airlines has opened an elaborate stewardess training facility here, and the handsome new school goes American a focused position in the increasingly intense airline competition for women to serve on its expanding transport fleets.

American's school is just the latest sign of the competition available to airlines have found themselves in over the past few years, trying to expand their stewardess forces to handle increased flight capacity while faced with the traditionally high turnover rate in stewardess ranks.

An American Airlines annex to the problem is the elaborate "College" built here to replace the old school at Chicago's Midway Airport. And the new school, located in a modern building built last week, left no doubt that this school is the apple of American management's eye.

A work of continuous tradition, American's board of directors held its monthly meeting at the school before closed-door sessions.

Speaker of the House of Representatives Dan Rostenkowski headed the list of debriefing speakers, and the first stewardess class arrived from Chicago to take over the school and go to work.

Lapport of School

American's Stewardess school is a building two-story structure built of West Texas fieldstone and set in a 21-acre wooded area across the road from American Center Field. The 51 million facility has a swimming pool and tennis courts, and eventually it will have a pet-and-pet golf course. The landscaped campus is enclosed by a chain-link fence.

Lower floor of the school is designed as a cultural, contemporary library

and includes first classroom, a reception area, recreation area, cafeteria and kitchen, and a lounge area. Upstairs, the girls live in 27 apartment suites.

Most of the bedrooms are linked in suites of two rooms with bathroom facilities between them. Normal privacy is done girls to a room, although they will handle five if necessary. Normal size of a stewardess room will be 125, but the school will take classes up to a maximum of 160 girls.

American flight girls will train approximately 1,000 stewardesses a year at the new training facility.

If the new school, the school can be expanded to handle larger classes. The U-shaped building can be closed with an extension on the fourth side, and some of the patio areas can be enclosed.

College Atmosphere

The attractions of this college approach to stewardess training should give American advantages in competition with other carriers for stewardess recruits.

It is a new approach of the general competition for flight personnel which has been increasing in airline capacity and between his expanded.

One of the trends that complicates expansion of present stewardess ranks is the high turnover rate. An average stewardess works about two years before she resigns, usually to get married. Last year, American trained nearly 700 stewardesses, most of them in replacement. The school currently has about 1,400 stewardesses.

Qualifications have been liberalized considerably since the post-World War II days when a stewardess had to be a married woman. A considerable amount of this liberalization has come in the past few years in the need for more

women but because once passing 16 years in aircraft one has contributed to the liberation of men, single and married, and these under standards can give carriers a bigger labor supply. American estimates it will interview more than 15,000 candidates for next year.

Stewardess Qualifications

To qualify for a job with American, a girl should be between 20 and 35 and between 5' 2" and 5' 8" in. Weight maximum is 140 lbs. Height is 5' 2" to 5' 8". The minimum is 180. In some college education is generally considered a minimum requirement for applicants.

Most carriers have requirements similar to these, and many of these have been broadened in recent years. And in some cases they can't find and find roles of an especially promising candidate comes along. A high school graduate can get into the school, but she can show some attractive business experience.

When a girl goes to work for American, the girls first transportation to the U.S. Worth school is provided. They live in dorms at the school, although an airfare is paid until graduation. Currently, stewardess salaries range from \$385 to \$370.

American finds it costs about \$580 to groom a stewardess from first interview to first flight.

Intensive Course

At the school, American puts the girls through an intensive 11-week course which includes theory of flight, meteorology, airline rules and codes, first aid, accident investigation, first aid, and social procedure and general personality.

The school is under the personal direction of Superintendent Mildred Aldrich, a veteran of 10 years in American's stewardess training program. Superintendent of training is Miss Anne O'Connor.

Regular school days for the trainees is a nine to five shift, but Miss O'Connor points out that extra training hours almost occur every evening. Two weekends during the period are spent taking observation flight as passengers, watching regular stewardesses operate. And two nights each week during a three-week period, the students take each other dinner on Cornett, DC-6 and DC-7 equipment to practice what has been taught in most service classes.

Several evenings are taken up with interviews with interviewers to check progress and iron out any problems. And some evenings are spent in the beauty salon where American girls are beautifully styled the usual short haircut to fit individual girls.

SHORTLINES

► **Aeromex de Mexico** has placed an order for three turbo-prop Lockheed Electra transports. The U.S. and two foreign airlines now have ordered a total of 144 Electras. Aeromex is the first Latin-American carrier to place an order for the transport.

► **American Airlines** will inaugurate last Captain's Flightday luxury service celebration between Detroit and New York. Similar service is now operated between Chicago and New York. Premium for the Detroit service is \$1 and the airline plans special prices at each end for the flight.

► **Boeing International Airways** granted \$46.7 million in operating reserves during the nine-month period ending Sept. 30, an increase of 74.7% over same period of 1956. Net operating income was \$14.4 million, a 4.7% increase. The airline's expenses for the period were up 22%. Revenue passenger miles operated increased 22% to a total of 77,530,540.

► **Northeast Airlines** lost 69.6% more revenue passenger miles during the first nine months of 1957 than during the same period of last year, the airline reports. The 1957 totals were 56,611 passenger and 157,490,000 passenger miles. The airline suspended its East Maine service in January. Total flights over its East Coast route to Miami in all of Dec. 1 went to be 20 daily with a 1,520-seat capacity on DC-8s.

► **Pan American World Airways** reports third quarter gross operating revenue of \$40,914,000 up from \$34,699,000 at third quarter 1956. Passenger revenue rose up 9.3% to \$7,142,000. Freight revenue rose up 25.2% to \$8,049,000. The carrier's expenses increased 11.4% while net income for the quarter was \$5,990,000 compared to \$6,708,000 in the same period of 1956. Net income at third quarter 1956 was \$2.3 million, while net income has been reduced since Dec. 1, 1956.

► **Tennessee Air Lines** plans to put Lockheed Super Constellation equipment on passenger and cargo routes between the West Coast and Glasgow Jan. 15. The replacement carrier on parts to schedule regular flights with trips at Houston, Wichita and Guam. Service has been provided with DC-4s.

► **Western Air Lines** carried \$2,385,860 in net income during the first nine months of 1957. Fourth quarter operating income was \$2,083,516, up 15% from third quarter 1956.

COCKPIT VIEWPOINT

By Capt. R. C. Robson



Fire Brigade or Study Group?

It may sound silly, but it's true, that more and more the required fuel loads on aircraft are being computed not on the basis of weather or winds or altitudes, but rather on the basis of probable traffic. Since traffic is not given data of arrival is even harder to forecast than the weather, that makes for impossible load computing in the field planning department. With steadily better data and subjected visibility aircraft can, and on occasion actually do, experience delays up to 45 min attempting to land at LaGuardia Field.

Such is the air traffic situation facing the new arrival. Airways Modernization Board. Obviously a man got down his actual hours of flight in order to make air and progress and we need progress but fast. No doubt this is why the ATIS is beginning to let contractors the analysis of various airport problems. We certainly would not want this project to go off half-cocked and act on misinformation.

On the other hand we cannot help wondering if ATIS is going to tell us the way to get into the "study group." If there is anything we don't need it is another learned analysis at the expense of action. It does seem that there should be sufficient quantities of paper left over from the new draft Air Navigation Development Board, from various groups of the Air Conditioning Committee, from Radio Technical Committee for Avionics and miscellaneous other places to request people with the problem.

There seems to be two distinct traps into which we ourselves fall. One is the apprehension of another committee to study the problem. The air traffic problem has been studied at numerous. We have isolated the problem. We have isolated the problem. We know what causes the problem. The study group is now getting around to doing it. Evidently a solution. Committee again to find that the expert is the thing. Get out the report and everything will fall into place. But out at the last accident one can hardly expect any results except more traffic and longer delays. Evidently committees learn with assurance that the problem they "solved" five years ago still exists.

The other common trap is that of "planning for the future." Few people seem sufficiently interested in doing something about existing conditions and existing traffic. It appears extremely more dangerous to work on time, perhaps for some future date. Right now we are all fired up about the high altitude, high speed problems of the jet. I would not for a moment attempt to minimize that objective but at the same time we should not avoid, the airway and airport matters that exist right now. The new sequences of completely working on long range plans is that the "now"-today's problem—never gets solved.

The ATIS has now five people in its ranks with plenty of work available. It should not delay itself that it can get by with more studies. The very nature of its birth puts the possibility of a life span consisting with that of the present Administration argues that it will have to show results in short order. All signs point to an air traffic state of colonial proportions in the coming years. Most progress than ever before will begin developing "on schedule" investigation, action started to lose control, and business interests will have their own board probably. Unintentional pressure will be placed on those in office, and lengthy statistical reports will be considered sufficient evidence for continued existence. As it is not, the wearing of even a mouse badge is of infinite more importance than the production of a warehouse full of well laid plans. Unless the ATIS can get into action and with a decision made in a hurry it stands a good chance of getting the work of other there and less letter suggestions now gone and forgotten.



AERIAL view taken from a helicopter shows the new American Airlines stewardess training facility at Ft. Worth, Tex. Two-story structure is linked by swimming pool, tennis courts and eventually will have pet-and-pet golf course.



Convair uses Silastic-covered wire throughout the F-56 Hustler. This wire meets MIL-W-8777 specifications. Because it stays rubbery, Silastic is also used for wire bundle clamp holders in the F-56.

SILASTIC[®] SILICONE RUBBER

Its resistance to heat, oils and solvents, specify Silastic LS

insulation stays rubbery at 500 F

Even continuous exposure to temperatures ranging from -130 to 500 F won't affect the resiliency or high dielectric strength of Silastic[®], the Dow Corning silicone rubber. Silastic repels moisture, resists weathering, ozone, aging and acids. That's why Silastic ensures peak insulation efficiency for electrical wire and cable. Offered by leading wire manufacturers.

Get latest data on Silastic. Mail coupon today

Dear General Corporation, Dear other
Business: Machine
Please send me latest data on Silastic

NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____
TITLE _____

SEND NO MONEY NOW. MAIL TO:

Typical Properties of Silastic for Wire and Cables

• Temperature range, °F	-130 to 500
• Tensile strength, psi	600 to 1500
• Elongation, %	150 to 450
• Insulation resistance, megohms/1000 ft	1000 to 5000
• Dielectric strength, volts mil	200 to 300
• Dielectric constant, 10 ³ cycles per second, nominal	2.5

If you consider MIL the properties of a silicone rubber, you'll specify SILASTIC

Stick to
silastic

Dow Corning CORPORATION
MIDLAND, MICHIGAN



High-flying "Hustler" equipped with Auto-Lite **350** Wire

Convair's B-58 "Hustler," designed for supersonic, high-altitude operation, uses Auto-Lite 350 High-Temperature Wire in many critical applications. Auto-Lite 350 Wire was developed to meet the extreme temperature and other physical demands of modern aircraft.

Other aircraft manufacturers, like Convair,

find the extra temperature range performance of Auto-Lite 350 Wire ideally suited to jet aircraft demands. Many manufacturers find that in addition to its high resistance to oxidation, flame, solvents, fuels, and lubricants, Auto-Lite 350 Wire reduces production costs, too, compared to other high-temperature wires.

- Resistant to temperatures below -80° F.
- Durable
- Resistant to moisture, oil, acid, alkalis, solvents, and fuels for both reciprocating and jet engine regions

- No alteration after 60 hours of continuous operation
- Flame resistant
- Easy printing of circuits with conventional marking machines

- Meets Spec. MIL-W-8777, U.S.A.F.
- Free shipping
- Manufactured in sizes 22 thru 18

For complete information on Auto-Lite Aircraft Wire, including specifications and samples, write to: The Electric Auto-Lite Company, Wire and Cable Division, Port Jervis, Michigan or Houston, Pennsylvania



AUTO-LITE[®] **350** GENERAL PURPOSE HIGH-TEMPERATURE AIRCRAFT WIRE

LOCKHEED T-33 Jet Trainer
Wing Sections by
BEECH Aircraft Corporation



BIG JOB for a small switch

The vital function of a landing gear indicator light demands a switch that is completely dependable and environment-free under all conditions. That's why Beech Aircraft Corp. has used Cole Hermetically Sealed Rotary Limit Switches in the more than 5,000 sets of wing sections it has built for Lockheed's T-33 Jet Trainer... another example of how major aircraft companies utilize the competent know-how of smaller manufacturers.

Cole Electric Co. makes a wide variety of special-purpose switches for the aircraft industry, including many hermetically-sealed types. Whatever your requirements, write us and we will recommend the switch that is appropriate for the purpose—or develop a special switch to serve your particular needs.

Cole Electric Co. Hermetically-Sealed Rotary Limit Switch 300° rotation, 2 pole, flexible three .20 comp, 28 volt D.C.



Cole
ELECTRIC CO.

8439 Skuller Drive
Culver City, Calif.
TElex 8-1701



Miniature Electrical Substation for Guided Missiles

Radar Saves Money, United Finds

New York—Before radar is saving dollars as well as increasing passenger comfort and safety. United Air Lines has found in a study of its experience with the state-of-the-art equipment.

The radar is proving its worth in reducing aircraft damage, delays, detours and other problems of flight during summer thunderstorms, according to the study conducted. Comparing the months April through September 1955 before the 54 radars were installed with against those months of 1956 and 1957, United found:

- Reduction in aircraft damage resulting from hail or thunderstorm turbulence. This problem had previously cost United an estimated \$400,000 annually.
- Cuts of static discharge were reduced 65%. Cost of this static had been about \$15,000 a year.
- Turbulence incidents such as loss of alt or loss points or detours at reduced cruising speeds decreased about 44%.
- Delays due to such turbulence incidents were reduced. These detours and reduced-speed operations had cost about \$150,000 a year.

Basis for Decision

According to the study, United's decision to buy the weather radar was based, in addition to safety and comfort factors, on an expectation of economic benefits. These have derived from the operating requirements met by the radar, including passenger comfort, schedule reliability, character of flight conditions because of thunderstorm conditions, better flight crew morale and other intangibles.

The report points out that a full evaluation of the radar is impossible because of variables such as difference in thunderstorm frequencies and intensities from year to year. Nevertheless, United finds that "there is certainly some evidence of radar paying its own way economically."

Data for the study was obtained in part from more than 1,000 reports filed in its flight crew on special radar reporting forms. These include personal reaction information, and 90% of the reaction was favorable. Pilots reported such results as "would have turned back and landed" without radar, "would have detoured 100 miles south," and "flight through the area impossible without radar."

In its comparison of more weather operations before and after radar, United noted 31 cases of static discharge in 1955. The next year, with its best 45% radar equipped, the cases dropped to 10. In 1957, with 95% radar, there were 18 cases.

Varied-coverage flight data, at the company's DC-7s amounted to an average of 278 miles per million miles flown in 1955, according to the study. This was down to 150 miles per million miles during the 1957 period.

The company's DC-7s averaged 168 miles of turbulence data per million miles before any of them were radar equipped. In 1957, with installation 65% complete, the average was 61 miles per million miles.

Flight crew response to the radar was 75% unaccounted, which the re-

port ascribes to lack of need for radar on a particular flight, or to impossibility of getting on route traffic control clearance along a desired detour path.

Reason for Disfavor

The report notes that radio-aided navigation, which totaled 35%, was mostly concerned with topographical landmarks or inadequate understanding of the limitations of the devices. No change in reliability, however, is comparable to other equipment of similar complexity, according to the study.

United began to take its first radar installation 1955 completed next month.

The New York Times

Feb. 6, 1957

CAPTAIN ANDRE LESIEUR

PILOT WITH A PAST...
AND A FUTURE

Captain Andre Lesieur, Staff Officer of Flight, is an important figure in the history of Air France. His experience flying Super Constellation over the Atlantic (100 crossings) will enable him to give the new Lockheed Super Constellation the best of his knowledge. He has been at the controls of Constellation and Constellation will be indispensable in the coming days to give him well-earned operational background. A pilot of the new Air France DC-7, he is now the Captain Lesieur who will make it possible to carry on Air France's record of dependability service in the presence of 12 members in the generation ahead.



AIR FRANCE

THE WORLD'S LARGEST AIRLINE
WITH 874/41 EMPLOYEES BASED IN
100 AIRCRAFT IN 20 AIRPORTS

80 Post Road, New York 17, N.Y. (New York office)
80 Post Road, New York 17, N.Y. (New York office)
80 Post Road, New York 17, N.Y. (New York office)
80 Post Road, New York 17, N.Y. (New York office)
80 Post Road, New York 17, N.Y. (New York office)
80 Post Road, New York 17, N.Y. (New York office)
80 Post Road, New York 17, N.Y. (New York office)
80 Post Road, New York 17, N.Y. (New York office)
80 Post Road, New York 17, N.Y. (New York office)
80 Post Road, New York 17, N.Y. (New York office)

Railway Express Bid Opposed

Washington—Civil Aeronautics Board Chairman Edward T. Stodola has recommended against a bid by Railway Express Agency for an international air freight forwarder and general agent for certain direct air carriers.

Railway Express proposed to operate as an international air freight forwarder between the U.S. and Mexico and foreign points except India, Hawaii, Canada, Cuba and other oceans and foreign points to which it now operates under the domestic air express agreement. In addition, it asked approval of

general agency agreements with Scandinavian & Western Airline, Transports Aeriens Nacassels (TAN) and Empresa de Transportes Aereos Riales (RELA). Stodola said there is no doubt that Railway Express could provide a useful new service. He agreed that the agency is in a position to generate much new international cargo, but its foreign non-stop services are not available elsewhere on the same scale, and that as an freight forwarder authority for the agency in combination with its existing facilities could provide wider service.

Other coverage, under service and other advantages of Railway Express' inter-modal service resources.

But, Stodola added "some agencies, merchandising and superior service is not enough. There are competition considerations, not the least of which is that the size and strength of REX's salesmen facilities and service resources would give it an undue competitive advantage."

Interest Conflict

As an international air freight forwarder, the carrier said, Railway Express would in time become subject to various conflicts of interest with its international service forwarding activities.

The said Railway Express at present offers a world-wide service forwarding operation by water through arrangements with a series of companies in foreign countries. The agency also has a wire line forwarding arrangement with the American Express Co. which functions as a surface forwarder. On some small shipments, air freight rates administered by air are not higher than the rates of the American Express Co., he said.

Under certain circumstances, Railway Express would have to weigh the incentives for promoting international air cargo as against existing such cargo on ocean carriers, according to Stodola.

As the cost of air transportation decreases with technological advances, he said, the area of competition between air and ocean carrier transportation will progressively increase.

Consequently, he said Railway Express is acting in the conflicting capacity of promoting both air and surface cargo services. Control of the agency by the railway network, he added, has exposed it to the greatest liabilities because as a rail express company, it is promoting not express of the export of air express and air freight. He added.

The proposed authorization of REX also raises other considerations of the possible wider interest influence on air freight transportation and the extent to which such influence may be detrimental to the full development of air cargo transportation.

Service Distinction

It is one thing for the individual express air freight forwarder who has several means of transportation available in the forwarding operation to use air service in conjunction with air service in moving cargo; it is another matter to assign the status of a company which owns by the individuals for public opportunity to promote and express at the expense of air freight.

Stodola said the amount of air cargo handled by Railway Express is such greater than the total air cargo tonnage handled by all of the international air freight forwarders combined.



All-weather flight for Helicopters

Sperry Announces Advanced Developments in Controls

To increase the all-weather capability of helicopter flight has been a continuous research and development program at Sperry. The newest development is a Stabilizing Control System adaptable to all types of rotary wing aircraft.

This new manufactured electronic system is designed for partial or fully automatic control to achieve stability during take-off, in flight, hovering and landing—in varying conditions of wind and weather. Use of accelerometers, redundant amplifiers and rugged mechanical components, engineered with traditional Sperry precision, give the new system great accuracy and reliability—all within small space and light weight for either the pilot or fully automatic systems.

Other Sperry developments for helicopters include a new Sperry All-Weather Integrated Instrument System, providing simplified display of all data for manual control, it includes flight

SPERRY BENEFITS OF THE NEW SYSTEM ARE:

Reduction of pilot fatigue. Constant stick loading is eliminated.

Accurate navigation. Precise flight is achieved under conditions of poor visibility and over unfamiliar terrain.

All-weather flight. Automatic system provides hands-off stability needed under all flight conditions.

Control stick clearing. The pilot generates command signals by moving stick as conventional manner.

Diveless Computer, Helicon Flight Director Indicator, Nivertone Computer, Compass Pedestal Displacement Indicator, Attitude Vertical Rate Indicator and RPM Control Systems (also available individually). If you have a requirement in helicopter controls and instrumentation, write our Aeronautical Equipment Division.

AERONAUTICAL EQUIPMENT DIVISION

SPERRY
STANDARD CORP.
BOSTON, MASS. 02108

DIVISION OF SPERRY RAND CORPORATION
MEMBER ORGANIZATION: AERONAUTICAL ENGINEERS
AND ENGINEERS 1. FORMERLY IN SPERRY RAND CORPORATION
CORPORATE IN GEORGETOWN, VIRGINIA, WASHINGTON, D.C.



**ELECTRICAL
INDICATING
INSTRUMENTS**



WHERE ELECTRONICS MEETS THE EYE

marion electronic instrument company
Austin, Pa., Hawthorne, New York City



ROTODYNE can carry a 10,000-lb. payload as 40 passengers in its present configuration. Noise suppressors are being tested on tip jets.

Rotodyne Built for Short-Haul Routes

By David A. Anderson

While Westland, England—Fairey Rotodyne, was in the early stages of its flight test program here (AW Nov. 18, p. 17), has been designed to beat both helicopter and fixed-wing transport on short-haul routes.

Rotodyne is a transcanted vehicle which combines helicopter takeoff and landing performance with the cruise

performance of a fixed-wing airplane. In its present configuration it can carry a 10,000-lb. payload or 40 passengers.

Design steps, length of the Rotodyne with fixed development of its Napier T1140 gas turbine are approximately 450 mi.

A larger fuselage will also be available for future models, to increase the passenger capacity to 50 and the cabin

height from the present cabin level to eight feet.

Major importance of the Rotodyne will be in its ability to operate from airfields to air-cargo with a large payload. The vital and highly competitive route from London to Paris now takes more than four hours by the fastest air route and an occasional one ground car in this time or an air speed of about 47 mph. Fairey says the Rotodyne can reduce this to less than two hours with an allowance of 14 min. for passenger handling and a 14-ft. reinforced signal in

Noise Level

One criticism of the design has been sound noise level of the present jet drive system. Observers at Farnborough, a couple of years back when the Jet Concorde test's chief was demonstrated was shocked by the high decibels in the noise level (AW Sept. 12, 1955 p. 17).

Since then, Fairey engineers have made considerable progress in development of a noise suppressor. With noise suppressors available, the engineers say, Rotodyne should be as quiet as the present day rotor helicopters at takeoff. After takeoff, the noise level of the Rotodyne

will reduce more sharply than that of the helicopter because of the difference in performance.

There is considerable technical interest in the Fairey design on both sides of the Atlantic. British European Airways has studied its performance and has shown positive interest in it. BAA's present and immediate future transport commitments have forced a "wait and see" attitude.

U. S. Potential

In the United States, New York Airways sees the Rotodyne as one possible answer to the problem of providing service to the middle of the metropolitan area without incurring the massive cost of its suburbs.

The International Air Transport Association recommendations for a helicopter transport are not exceeded in every category by the Rotodyne. Both call for 40 to 50 passengers. IATA sets for operating costs of five cents per mile and Fairey quotes their costs. IATA wants a 150 mph cruise speed and the Rotodyne should make 170 mph. The IATA range of 200 mi. is more than doubled with the Rotodyne's 450 mi. And the required rate of climb at maximum power is 1,670 ft./min. for the Rotodyne against the recommended figure of 800 ft./min.

Fairey has calculated a weight increase for a conventional helicopter and for the Rotodyne. Comparisons are generally obvious, but Fairey has had enough experience in both types of aircraft to make some reasonable estimates. It further put everything into percentages of gross weight, so that some uncertainties are covered.

The comparison shows the Rotodyne structure weighs 17.9% against a helicopter's 25%. The powerplant and rotor drive is 18.5% of the Rotodyne, and 20.5% of the helicopter. Rotor's engine are close at 13.9% for the Rotodyne and 12.1% for the helicopter, equipment is also close at 30% on the Rotodyne and 26% on the helicopter.

The result of the Rotodyne is that the cross-country helicopter has available 25% of its gross weight for payload, but the Rotodyne is shown to have 39.4% payload load.

Rotodyne Description

Acoustically, the Rotodyne combines some of the principles of an autogiro, a helicopter and a fixed wing aircraft in its layout. It is designed around a unique lifting and propulsion system which utilizes a jet-driven rotor, a fixed wing and twin Napier T1140 turboprops driving rotors on a common shaft as well as conventional propellers.

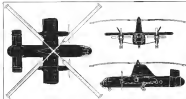
The entire lifting and propulsion system is an integral unit mounted on top of the base fuselage. It features



CANTER began action of vertical stabilizer as Rotodyne was lowered before flight testing.



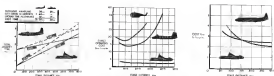
FAIREY's blade wheel test stand at Farnborough shows Rotodyne powerplant and rotor.



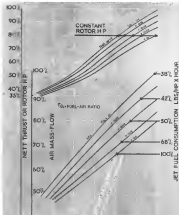
ROTODYNE has 90-ft. diameter rotor, base height is 5 ft. Fixed wing has constant chord.



90000's of Rotodyne's are open into 5-ft. wide, 6-ft. high, 40-ft. long compartment.



TOTAL time on a trip compares Rotolife with conventional airplane (left). Lower costs are claimed by Rotolife in comparison to one-engine single and two-engine helicopters (center). Vincent and Rotolife cost comparisons show a crossover point at range of about 150 mi (right)



PERFORMANCE CHARACTERISTIC OF A
PRESSURE JET ROTOR (AT CONSTANT
ROTOR R.P.M.)

PERFORMANCE of the Form 3 manuscript version of helicopter graphics is compared in the chart. The typography on the Rotablowers are Form 3 developments that have been tested extensively in flight with the Jet Commander and are the closest to a number of test configurations.

questions should specify a complete set of fringes or other kind of groups and naming convention the Robotics could be easily adapted to the new situation.

The first wing of the Batoidae is rectangular, with constant chord. It is inserted on top of the flagellum near the growth center. The two flagella are curved outward on the wing at about the median longitudinal sutural vein and various complete the feeding portion of the Batoidae process.

Also revealed near the growing center is a fossilized 90-ft diameter crater formed by fast lower pressure gas at the top. This crater can be powered to gas lift as a helicopter as shown in cutaway, in a perfectly unlined condition as an outcome.

Water Power

The rotor is driven by air pumped from the ambient compressors by the Honda 1.6-litre compressor drive unit, supplying you of blades through a constant ratio gear in the event of a single-stage failure, the screaming engine continues to supply power to half the rotor.

For vertical takeoff and landing, the fuel is injected into the pressure jet and burned to give the maximum initial horsepower. During the flight stages, the propellers on the Flanders operate at near fixed positions.

Transition to horizontal flight is done by increasing the propeller blade pitch so that the airplane begins to move forward. As it moves, the fuel pump begins to receive more and more of the total weight of the Rotax engine as lift and the rotor can be unloaded. This is done by cutting off the air supply and the fuel, and the rotor goes into the overspeeding phase.

Should an engine fail in hovering flight the Rotax can continue to hover at normal gross weight on the remaining engine power drawing half the torque. If the failure occurs in cruise flight the Rotax can climb at

The larval development is hard to classify because at various times during its several instars it is a helicopter and at other times it is not quite an caterpillar and almost an airplane. It isn't a caterpillar in the usual accepted sense, there is nothing so constant except the neuroanatomic basis which deals from roter to wings.

Thus difficulty showed first in the design criteria for the Bioscience. Since it was obvious no single type of aircraft, it had to be designed to match all the thinkable conditions of all the possible future events.

Please see Dettlmeir

So the Navy design team under Dr. George S. Uhlig pinned the Batdyns to exact British war ordnance requirements for ballistics and for a comparable fixating result. Inevitably, there were conditions where neither of these criteria could apply, and that took considerable ingenuity to overcome.

Single-engine performance, for example, was calculated to record trans-ATA requirements for helicopters by a combined company. The performance also made fuel-wing segment requirements. The Rotabond also fits it to the normal gross weight of 70,000 lb on hot days up to ISA plus 15C temperatures.

The inter-laminar the control of the Basalganglia in pitch and roll for very different nonlinear pitch is given



NOTE COMPARISON with conventional two rotor helicopter is shown to have Rotodyne after takeoff. Black dots are for Rotodyne, white dots are for helicopter. Example one starts after takeoff, Rotodyne rises to about 74 db, while helicopter is close to 100 db. 1,000 ft. from island

Both collective and cyclic pitch thoughts are fed to the rotar drive, a hydraulic control system actuated by the linear two-stroke system of the helicopter. The pilot's left hand operates the collective pitch lever which also mounts a ravel throttle grip on the top. His right hand operates the cyclic pitch.

Elevator Control

There are elevators on the Rotunda but they are essentially only transoms and are operated electrically, actuated by a switch on the cyclo-pitch stick.

Even if both engines should fail and there is no power transmitted to the rotors, the control system can still be used because the auto-rotating rotors drive its own emergency hydraulic system.

Differential pitch control is fed to the propeller through the pilot's foot pedals by way of a mechanical linkage on the clutch control of the auxiliary compressor. Reverse power for control in use has to be available when the compressors are clutched in, the exact balance of the linkage and the control system will have to be determined from the flight test results.

The reasons why that stability and control in forward flight are impossible to use, fixed-wing aircraft. For those reasons they are confident that the Robobee will be an all weather morpho with advantages that no fixed wing conventional craft could have in closeness of approach and delivery.

Pressure-Let System

The tip joints on the *Heliochus* are a later development that have been tried extensively in flight with the RB Division and on the ground in a number of test conditions.

In solar hot burners the designer has a choice of two general approaches. First, he can design a burner with radial symmetry with respect to the rotation axis, so that only the coldest products have to be turned through 90 deg. and exhausted. Or second, he can select tangential burning so that the inlet air to the burner has to be turned. The first system is used in the Rotor Ultra Light (AW No. 4, p. 107); the second, in the Sun-Gas, and the Rotaburn.

Like other designs, the trapezoidal burner is also a compromise. It is better than the solid top in ease of manufacture and in its ability to take outflow processes and heat transport into. But there is a permanent drop due to the tapering, and the air entering is in an asymmetric pattern, making its natural combustion difficult.

Combustion chamber bars were developed specifically for the integrated burner of the Rotolox. The small design of the chamber has permitted



Multiple functions and separate fluid systems can be combined and serviced with maximum efficiency by a single Genover 4000.

Engine designers have recently been strongly attracted by Geragor pumps which permit the incorporation of an extra pumping element in a separate chamber of the lubricating pump to provide fluid pressure for a control function or other use.

The unique construction of the Gyrostar type pump provides wear-free systems.



positive hydraulic function pump systems and motors up to pressures of about 3000 psi may be evaluated in this manner. Also see p. 14. The **diverter pump** is relatively simple. The motor elements are the

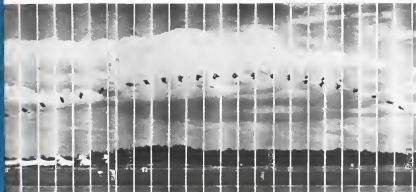
method "Geometry" — wings and sails. Both terms in the same function and either can may be driven. The same element, however, has one less look.



Advantages — The Gerator is a positive displacement pump. It is simple and compact, lightweight, vibrationless, provides high volumetric and mechanical efficiency.

Technical information plus complete custom engineering and precision manufacturing facilities are available to help you obtain the pump to meet your specifications. Your inquiry is invited.

W. H. NICHOLS CO.
65 Market Ave., Waltham, Ed. Mass.



**Daring Live Demonstration
at U.S. Navy's
Air Test Center at Patuxent**

Conducted jointly by the Navy and Grumman Aircraft, this evaluation study of the Marine Raider system was made a major step toward proving the ultimate in safety for pilots of high performance military aircraft. The test was performed from a Grumman F4F-OT Cooper two-seat jet fighter-trainer flying just off the ground at 120 knots. At the runway's end, the jetliner was fired by catapult high enough into the air to provide time for three stages of parachute to open for safe descent to the ground. Grumman plans to resume its evaluation program of speeds up to 400 knots. This is a record example of the scope of Grumman's Flight Test Service.

**GRUMMAN FLIGHT TEST SERVICE
UTILIZED BY THE MILITARY**

Now available to component manufacturers—Grumman's Flight Test Service. Here's what it is. Many years of testing experience of both military and business aircraft. Facilities both on Long Island and in Florida that allow for year-round test programs. In addition, test units at Edwards Air Force Base in California and at the Naval Air Test Center in Maryland. Operations can be conducted anywhere—60 field service representatives serve over 150 military units throughout the world. 250 engineers and supporting personnel who possess the many skills in

conducting flight development and demonstration programs—which include performance, stability and control, flutter and vibration, carrier suitability, power plant, weapons systems, equipment tests, etc., isolated test areas, specialized shops, complete instrumentation, automatic data processing and comprehensive equipment. Now available to you! It's fully described in a new 20-page guidebook entitled *Flight Test by Grumman*. Write for your free copy. Fill in coupon, attach to your letterhead, and mail today!



GRUMMAN AIRCRAFT ENGINEERING CORPORATION
Dept. AW, Bethpage, N. Y.

The interested in learning more about Grumman's Flight Test Service. Please send me the 20-page guidebook *FLIGHT TEST BY GRUMMAN*.

NAME _____ TITLE _____
COMPANY _____
STREET _____ CITY _____ STATE _____



HELPS PUT PROFIT
INTO MANUFACTURING

Heintz Achieves Volume Production with New Seiaky Counter Control Welders

In fabricating jet engine parts, where a wide variety of assemblies must be welded to rigid specifications every day, Seiaky resistance welding helps keep production schedules on schedule. The Jet Engine Division of the Heintz Division, Kelsey-Rayco Company, a large Philadelphia contract manufacturer, manufactures integral and replacement parts for the aircraft industry. The means their production must meet exacting jet engine specifications.

New Seiaky Counter Control

To help meet these requirements, Heintz now uses Seiaky Patented Three-Phase Resistance Welders with the new Preprogrammed Electronic Counter Control. This new unit provides precise control of all welder functions for accurate production consistency. All control settings are retained with extreme accuracy, and are readily reproduced at any time to duplicate previous production runs. The machine cannot deviate from its setting.



Fig. 1 Seam welding Niuectic to Niuectic on Pratt & Whitney Avral 1-J-37 afterburner after section.



Fig. 2 Seam welding stainless on stainless on Pratt & Whitney Avral 1-J-37 jet engine transition duct assembly. Note single fingers used.

The Seiaky Preprogrammed Electronic Counter Weld Control is the only control of this type that has been proved in service, and the first use of this kind has now been to use nearly two years.

How It Works

The Seiaky Preprogrammed Electronic Counter Control counts the cycles of power line frequency which is governed by the U.S. Naval Observatory. Its preprogrammed electronic counters, relays and switches are simple controlled by a Delatron tube to control the duration of the various welder functions. The absolute consistency of the count eliminates the need for time-consuming preweld check-out or calibration. Plug-in feature permits easy unit replacement, or addition of other control functions if required.

Operations Performed

These show typical Seiaky resistance welding applications on jet engine parts—Afterburners, Screens, Screen Engine Duct Assemblies, etc. Most jobs welded include Nickel Alloy Stainless and Stainless Steel.

Information Available

Case histories outlining the successful use of Seiaky Resistance Welding Techniques on jet engine components are available on request. Specific recommendations will be furnished on receipt of an outline of your requirements.

Write today, mentioning the literature you would like to receive. There is no obligation. Seiaky Bureau, 4803 W. 47th St., Chicago 38, IL. PD-100000-1-5000.

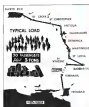


CHART shows a typical load which Dayton Instrument will design and build your test equipment.

the use of automobile-grade or gasoline, kerosene and aviation gasoline.

The blade drive section compresses through cylinders. Air passes from the compressor through a regulating valve to the solar head and then into the three circular ducts inside the solar blade. Flowing radially outward the air enters the combustion chamber. Fuel for the system is pumped from the wing tanks by a low-pressure pump through a regulator which reduces the fuel flow to the air mass flow, and to the solar head. In the head the fuel is distributed at low pressure to the three fuel lines. The controlling limit of the burning rate inside the fuel plane is about 1,000 psi at the tip, but it enters the combustion chamber through fuel gun nozzles.

Power regulation is simply a matter of throttling the air supply by the regulating valve. This valve is operated by the collecting push lever which has an outside control of the fuel-grip type on top.

Noise Reduction

After design work, an acoustic engineer came about five years ago and reached the same conclusion everybody else had: noise is reduced when the relative velocity between the jet and the ambient air is reduced.

This was the dominant idea whether it was to get out into the ambient air along a large propeller rather than through a narrow duct orifice.

When one results with a shape anything but a circle will in theory produce less noise. In practice it will also produce less thrust and the job of the engineer is to find the best balance between thrust and not reduced yet much less noise. There are also problems of drag and weight.

Forces built and tested several dozen

DAYSTROM INSTRUMENT WILL DESIGN AND BUILD YOUR SPECIAL TEST EQUIPMENT

We Have the Engineers and Facilities for
RESEARCH, DEVELOPMENT and PRODUCTION



Our highly skilled research and development engineers are experts in defining, designing and engineering test equipment. We are delivering test equipment of a highly specialized nature for both military and commercial applications.



Add to this Daystrom's ability to supply pilot parts to prove such designs . . . and a complete facility for volume production, and you'll understand why, MORE AND MORE, the Armed Services and industry are turning to Daystrom Instrument.

Consider Daystrom when you have test equipment requirements which must meet the most strict standards.



**DAYSTROM
INSTRUMENT**

Division of Daystrom Inc.

Archbald, Pennsylvania

Two seconds of hell!

In a matter of seconds, metals undergo their most severe test as shock and powerful pockets and guided missiles blast into action. Here thin-wall, precision-made metallic tubing helps minimize rotor stress.

WALLACE Pneumatic Tube Company produces thin-wall tubing in a variety of metals with wall thicknesses ranging from .003" .050" and diameters from 1/8" O.D. to 8" O.D. Details of product are given in booklet, which will be sent on request.

WESTERN

PNEUMATIC TUBE COMPANY
TOLSON, WASHINGTON

Western Division
Pneumatic Tube Co., Inc., 11000 York
Boulevard, Dallas, Texas
Pneumatic Tube Co., Inc.,
2100 South
1st Street, Phoenix, Arizona
Pneumatic Tube Co., Inc.,
2100 South
1st Street, Phoenix, Arizona



HOW Bell 4 and its engine performs



COIT shows of prototype development models show evolution of 1995. Buckle at right an early point on capacity usage curve.

type of exhaust nozzle to get engine over and some reduction of the right track for development. Right now it has a more upstream which it has proved will drop the Bellodyne rocket down to that of a current helicopter. Actual mass level has been dropped from somewhere around 100 lb. to about 95 lb., comparable to the rest of a rotor system.

Some current plans made for the Bellodyne have shown that at takeoff, the level is about the same for both the Bellodyne and the rotor helicopter. But as soon as the Bellodyne is off the ground and firing its superior performance reduces the mass level faster than in the case of the helicopter.

Development History

The Bellodyne principle is 10 years old at best, because it was in 1947 that the company started work on development of pneumatic duct. The aircraft project was a 2,600-lb. helicopter with a propeller for forward flight and the combustion chamber, with a thrust of 75 lb., was completely developed and tested.

But within three years it became obvious that the real future for such a propulsion scheme lay in its application to large rotors. The 2,600-lb. helicopter went out the window, and a large transport type came in its place.

Development of the Jet Gyrodrive was initiated to get some background of experience with jet-propulsion

and the touch, problem of transition from hovering to forward flight. This work kicked off the development of new jet ducts at the company's facility at Wright-Wheeler. In the end of 1953 the combustion chamber for the Jet Gyrodrive was completed and the plane flew in January 1954.

While this was going on, British Foreign Airways needed its specifications for a transport helicopter. BEA asked for 40 seats instead of the former number of 25, and wanted a rotorless design. The second appearance of the Bellodyne was launched, like its combustion chamber, concept in duct (AW Oct. 6, 1953, p. 17). It had a five-bladed rotor of 90 ft. diameter and a pair of gas turbines de-

signed another engine. Free wings were to be used to unload the rotor in level flight and the whole idea was essentially similar to the machine now flying.

Completely new test bases and apparatus were needed and built to cope with the extended scope of the Bellodyne program. Today the jet drive is chosen at 100 ft. in capacity and variable in scope. They include tethering sites and spinning rigs for the Bellodyne and the Ultra Light, a water-suppression test area and even hydrogen sites test rigs for the Bellodyne and Ultra Light, using a Napier plant and a Bell-Ross Dart engine respectively for power supply and compressed air.



How thermal flux test facility's control panel is at left, 150 psi pressure vessel at right.

Facility Studies Re-Entry Effects

San Antonio—High temperature re-entry facilities has been developed here by Southwest Research Institute under sponsorship of National Aeronautics and Space Administration.

High thermal flux testing facility now

operating at Southwest Research Institute has reached average temperature about 7,000° F., and it is believed the new facility can go as high as 9,000° F. Facility will be used to test the effects of high energy concentrations, of light and heat on chemical and physical properties of materials, and can be used for research on problems for reentry into the atmosphere involved in U.S. ballistic missile programs.

NACA installation has a high intensity arc using carbon electrodes. It operates in arc without the need for water stabilization, reducing possibility of such electrode factors as water vapor interfering results. Unit is designed to a pressure vessel capable of handling pressures up to 150 psi.

Status of pneumatic rotors, ducts, engine from the re-entry test spectra. Apparatus is held in a specially designed holder which permits control of pressure and gas composition. That,



Carbon electrode in pressure vessel arc exposed. Test employs high intensity arc



Work where PUMP ENGINEERING reaches its peak!

It takes exceptional pumps to feed the most powerful propulsion systems ever built—the Long Rocket Engines. And it takes an exceptional center for the men who develop these pumps.

Rocketdyne offers the most interesting opportunity in the pump engineering field today. Your experience with commercial pumps and compressors will be extremely useful—a help solve problems of load capacity, power and speed never before encountered. You'll gain both mental and professional experience that is irreplaceable elsewhere. Your contributions to the advanced techniques of pump design will be recognized and rewarded.

Rocketdyne builds high thrust rocket propulsion systems for America's major rockets. You'll work with the leading specialist in the nation's finest growth industry.

If you are an experienced pump engineer with the ambition to break new ground, and to show yourself a pioneer, your creative ability can give you a new career for you in Rocket Engineering—more challenging and more valuable to you than the most you are now doing. Write: Mr. A. W. Johnson, Rocketdyne Research and Development Dept., 9015, 9035 Chicago Avenue, Chicago Park, California.

ROCKETDYNE

A DIVISION OF ROCKET ENGINEERING COMPANY
BUILDERS OF POWER FOR OUTER SPACE



500 mils to 500 amps



and 50 to 2800 pV



Sarkes Tarzian SILICON RECTIFIERS

offer the design engineer a wide range of ratings to simplify tough design problems. Mass production techniques coupled with rigid quality control, provide excellent performance at low cost.

HEAVY CURRENT SERIES

From 50 to 300 volts peak inverse and from 20 to 200 amperes dc.

HIGH VOLTAGE SERIES

From 800 to 2800 volts peak inverse and from 325 to 450 milliamperes dc.

TUBE REPLACEMENT SERIES

Replace 95% of the popular octal base rectifier tubes, including 5U4, 5AU4, and 5R4.

HERMETICALLY SEALED SERIES

From 50 to 400 volts peak inverse and from 500 milliamperes to 15 amperes dc.

L AND M SERIES

From 100 to 400 volts peak inverse and from 500 milliamperes to 1.5 amperes dc.

Send for data sheets.

RECTIFIER DIVISION
DEPT. AW-6

415 NORTH COLLEGE AVE., BLOOMINGTON, IND.



SYSTEM of probeless waves (one visible at red) detects range from 10 to 100,000

conditions met by a ballistic missile on re-entry can be closely simulated.

Results of tests are photographed through a pin at the end of the pressure vessel in a camera shooting at the rate of 1,800 frames per second. Test procedure is completed through a thermal couple activated for each fraction of a second to precast melting. Specimens are examined by several methods, including electron microscope and X-ray diffraction.

Hawker Caneesh P.1121 For Lack of Interest

London—Hawker Siddley has stopped development work on its P.1121 supersonic strike aircraft and "reopened" the acceptance package. This was disclosed here at a conference in which officials also revealed that the group which two years ago decided 50% of its effort to aviation, now has shifted its emphasis so rapidly that only 10% of its current efforts are in the aircraft field.

Sam Frank Springs, Hawker Siddley managing director, and work had been stopped on the P.1121, which the group was developing with its own money, because no customer had been found for it. The North Atlantic Treaty Organization showed some interest, he said, but nothing further has materialized.

Total assets of the Hawker Siddley group, including its large Canadian interests, are \$594.2 million, it was revealed for the first time. Total group turnover this year is at a rate of \$779 million a year.

Springs emphasized that while the military aviation engine was expanding and broadening its base, there was no intention of abandoning the aviation field entirely.

Hawker Aircraft has enough orders for the Hunter fighter to keep its assembly line going for another four years in spite of the government cut-



How Much Torque Capacity Can Be Handled In An Inch?

The largest Formsprag clutch shown at left measures less than two inches—weighs about the same as your cigarette lighter—yet delivers more torque per cubic inch than any other available today.

Good news for aircraft, marine and rocket engineers whose job it is to pack more and more power into less and less space. For example, here's how two aircraft engineers in manufacturers have taken advantage of Formsprag's unique clutch design...

A landing gear manufacturer has employed Formsprag clutches to overcome the primary hydraulic system so that in case of emergency the pilot can activate the landing gear mechanically.

An accessory gun turbine manufacturer uses a Formsprag clutch in a disengaging device on a starting mechanism.

If you would like to know more about how Formsprag clutches may be of help in solving your design problems, why not have a talk with a Formsprag engineering consultant?

SEND FOR LITERATURE . . .

ask for new paper entitled "Design Considerations for High Speed Over-Running Clutches."



Over-Running, Isolating and Backdriving Clutches for aircraft, automotive and various industrial applications.

FORMSPRAG COMPANY

23395 HOOVER ROAD, WARREN DISTRICT, MICHIGAN
World's largest exclusive manufacturer of over-running clutches.



IN CANADA: 750 VICTORIA RD., TORONTO 6, ONT. M6G 2B6
BIRMINGHAM: 401 AVENUE, BIRMINGHAM, ALA. 35202



FASTBREAK meditation on the English Electric F15 random in roller version. Web report (AW Sept. 16, p. 26) of world location on business side. Assessment of the instrument includes a map of the 20th Street railroad because muscles and bone. Ads: 10 new users.

Firestreak Groomed for Operational Use

By David A. Anderson

Harfield, England - The Harfield Firebrick refractory burning furnace is about to enter full production for both Royal Air Force and Royal Navy.

The six-hour course has been standardized as a requirement for Navy's de Havilland Sea Vixen and RAF's English Electric P1B and Gloster Javelin. It is

the second artificial month among British aircraft. First was Fagot, Pirelli, a benzene-rich diet powered by two solid propellant rockets.

The Huddersfield is completing a new factory for Forestal, final assembly at Walsden in Lancashire and meantime has established master engineering and production teams in various parts of the country.

They are working now to repair track lost during the engineering strike earlier this fall and to supply the huge demand for live development test rounds for field tests on foreign aircraft.

College Abstracts

Firestreak can also be matched to the North American Silver series, Hardtail Vireos and San Vicente Humbird. Hunter and Saunders Roe 55 Ltd. recently has been kind from the Antioquia-bank Azar Silver at the present ground at Wismar, and from Vireos in England and from Crows.

Entire responsibility for design, development and production of Furukawa has been given to de Havilland Propellers Ltd, under the British approach to the weapons system concept.

First, the word named *šlac* [sɛj in Arabic (male; masculine)] is easily recognized by the unique shape of its case, which consists of eight triangular opposite flat parts of least resistant size.

Behind the head stretches a cylindrical body about eight inches in diameter. Four fixed, triangular wings of very low aspect ratio are mounted behind the gravitational center of the body. Low down one wing chord length behind are four movable rectangular control surfaces of low aspect ratio.

Event Slide

Perceplant is a single sided perceptible noise which discharges through a small duct surface and noise. Division of housing is short so Perceplant can be considered to follow a hysteresis transition.

Overall length is 10 ft 6 in. Wing span is about 12 in. Wings and control surfaces are in the same plane, and are inclined at 91 deg. with respect to a horizontal plane through the thrust line of the nozzle when the F-600 is mounted on the nearest surface.

An interval part of the notation is as

lanching rock, a 5 ft assembly of anodized aluminum alloy. It carries a single attachment point similar to a bench rock, plus two lanching points which mate with corresponding sockets.

on a bomb rack, a weight hangs on an underlying piston. Sensors for the Firestick module are built into the heavier rack, so that the entire assembly, of rack, piston module is a self-contained unit which only has to be attached to the exploit and plugged electrically into the plane's power supply system.

Flexibility of the Firshtok installation was shown at the 1997 Society of British Aircraft Constructors display at Farnborough (AW Sept 9, p 26). Typical arrangement layouts included:

• **Single sounds** at both wingtips of the Sanden Roe 55 wind-powerplant in the pines. Plants were down and flowers with damaged sounds at were all within at Lureborough. Sanden Roe 55: the plants and sounds have been matched acoustically but no live sounds have been filed.

- Four nondescript singly attached to undivided short pedicels under the wings of the *Sca Virgo*, one of the sirpents which the man's will arm

• Four sounds attached under the wings of a *Glossy Ibis* in a similar installation but with longer poles under the wings. Bullet lacquer was added to



UNUSUAL position of the Maryland hardback, made as shown in the case of the English blower F 10. Note the spoked intake with its central bolt, designed to have an angled shock, and the sharp lip of the intake duct, which was designed to reduce drag.

the pasture of the poles and the wing leading edge to smooth the flow over that critical area.

- Two night rounds mounted on Puma underneath the Hawker Hunter nose.

- Two single cones mounted on each horizontal pylon below the cockpit as a model of the English Electric P.1B.

No details were available on the cockpit installation and the necessary auxiliary equipment needed to make the module usable on an aircraft. But for basic simplicity of the infrared homing system is that there is no need for on-board decoupling radars.

The heaving head is tied into the

a manual fire control radar supplied in the fighters which the missile uses. The radar is used in the conventional manner to pick up the target, but after acquisition the fire radar bearing lead permanently locks on to the infrared source and this is locked through the fire and null interposition.

With an eye on export sales of the weapon, de Havilland has stated that—in one case, for example—the effectiveness of the Sabre series can be improved even further by installation of the bar-

strain. They say the muscle can be fired from considerably below and beyond a target. Locked range must be on the order of several miles, perhaps five miles would be a reasonable estimate.

Internally, Focustek consists of an expert assembler/gadgets control system, image vision, power supply, movement and motion.

All of the "joined part" case, the muscle increases slightly in diameter 50 its maximum. This trained action must contain all the guidance, control, bracing and power systems.

Control surfaces are at the aft end of this tapered section, and transmit their motions to the control surfaces at the

IMMEDIATE FLIGHT (achieved by four components of the aircraft's fuselage-mounted tank and tail) recovers the full thrust of a de Havilland Fastback during landing, with no ill effects. Tank part of a program for the English Electric plane, second tank pressure and temperature on the airplane during landing. Voated tank is cylindrical socket covers that designed to increase F18's altitude performance.





Lockheed's new propjet airfreighter...

HERCULES



—loads more freight faster—sifts it further, in less time, at lower cost-per-ton mile than any commercial cargo carrier now flying



Hercules offers airlines a new kind of global airfreighter for the 21st Age of Transportation.

Unsurpassed Loadability: Under its own power Hercules can back up to a dock as easily as a truck. Cargo floor is deck and truckbed height. Hays 9' x 30' air cargo door permits straight-in loading/unloading. Forward 9' x 7' cargo door makes possible maintenance on-and off cargo loading. Hercules is the only airfreighter

designed to make full use of today's loading aids and tomorrow's revolutionary mechanized air cargo handling systems.

Highly Propjet Power: Hercules, with 4 Allison turbine engines (developing 16,000 h. p.), delivers unmatched pitch propellers. Will set new world's records for economy, efficiency, and outstanding performance. Hercules can land and taxi off from short, tapered fields under conditions impossible for other 4-engine

transporters carrying equivalent payload. **Unmatched Airdrop Utility:** No other cargo plane can compete on even terms with Hercules in its ability to do so many different freight-carrying jobs as well—as its low or high altitude, in blizzards, desert heat or arctic snow and ice. *From cargo dock to cargo dock, around the globe, no other airfreighter can match Hercules in shifting the goods of the world—at a profit to airline operators.*

LOCKHEED means leadership

GEORGIA DIVISION, Lockheed Aircraft Corporation, Marietta, Georgia

tail by means of cables. The cables run outside of the sustainer rocket under the long aerodynamic bracing cable at the wing root attachment to the fuselage of the missile.

The sustainer rocket extends over the length covered by the cable bracing. None of the sounds stored at Farnborough had positive acoustic or tail cones, but it has been reported that the rocket discharges through a circular section of ducting into a conventional nozzle.

The worked design must early be wrapped around the sustainer which is just ahead of the missile control surfaces. Such smaller warheads in tail sections have been used on missiles in the U. S.

Company Decision

De Havilland Propellers got into the missile business as a result of a company decision to do so. It felt its competence in engine and hydraulic system development work would be a useful background for the development of new weapons. In this respect its attitude was similar to that of Curtiss Propellers and Hamilton Standard in the United States, both of whom got into development of aircraft work, but directly related to propellers but drawing on the experience gained in propeller design, development and manufacture.

The progress developed progressively, after passing the acceptance stage. Performance of the turbo-sustainer in flight was the next item to be checked and sounds with the test installed were kind at Larkhill. All of these test sounds were short duration, limited by conditions of engine safety. But before their final flight was

Test number of turbo-sustainer now working on the inside side of the Havilland Propellers in "several thousand," the company says.

First work in the new field started when de Havilland was asked by the Ministry of Supply to develop a turbo-sustainer. Work on this unit was followed by a second contract for the development of an infrared homing head, following through the original work done by the Ministry's radar research establishment.

With both jobs almost completed, de Havilland got a development contract for a complete missile and in particular analysis of the requirements, decided to do all the design and manufacturing within the company.

The main principle of Firststock used a booster rocket at launching, and it was natural that the first firing tests should be to check booster operation. The tests were made at the Royal Artillery Range at Larkhill in Southern England.

The progress developed progressively, after passing the acceptance stage.

Performance of the turbo-sustainer in flight was the next item to be checked and sounds with the test installed were kind at Larkhill. All of these test sounds were short duration, limited by conditions of engine safety. But before their final flight was

OptiTherm® Radiometers first in infrared Radiation studies



A Raytek OptiTherm Radiometer is used for precise quantitative infrared radiation studies of military targets or backgrounds. These instruments are so rugged and reliable that they have been successfully used in airborne as well as field studies. Raytek equipment was the overwhelming choice of a majority of the participating groups in the pioneering ARDC Infrared Measuring Program.

Raytek's 4" and 8" Radiometers feature thermistor detectors, uniformly sensitive from ultraviolet to far infrared, or cooled and vacuumed photoconductors for specific wavelengths, an internal black body reference standard, for accurate absolute measurements, single or dual channel operation. Temperature differentials as small as 0.01°C can be detected with a speed of response as fast as 16 milliseconds.

Advances in radiation and non-contact temperature measurement are made in developments that originated with the Raytek Division at Santa Barbara Engineering. They are, equipped and trained to develop your infrared systems. If you are thinking of using infrared, write for complete information on the advanced line of Raytek OptiTherm infrared radiometers, sensors, detectors and components.



RAYTEK ENGINEERING COMPANY
Santa Barbara, Connecticut

Are you on the mailing list for "TECHNOLOGY"? Do publications, or information in development in infrared detection, will be sent on request.



Snark Gets Boost

USAF's Northrop Snark SM-62 intercontinental missile broke 5,000 mi. flight over the South Atlantic Ocean after being launched from the Air Force Missile Test Center at Eglin AFB, Fla. After some longer flying of Pratt & Whitney J57-powered missile.

SAF-T-MATIC



the first complete plug-in restraint system...

SAF-T-MATIC is a unique new emergency ejection system especially suited for combat and private aircraft installations. For the first time both comfort and convenience are incorporated into a single, complete system that provides absolute maximum safety.

The SAF-T-MATIC system consists of Pacific's "Roll-back" Shoulder Restraint Seat with integral shoulder straps and a specially designed plug-in lap belt and buckle. Combined, these two units allow the user to attach both lap belt and shoulder harness components in a matter of seconds. Quick adjustment is just a simple pull on the strap ends until the desired position is achieved.

When being used, the Roll-back allows full freedom of movement—unless an emergency should occur. Once then, the automatic Roll-back takes over, instantly lock and reverses the user from any force which tends to throw him from the seat—in any direction!

The SAF-T-MATIC buckle has a quick release feature which instantly disconnects both shoulder straps and lap belt. Although by no means rare at the buckle face is obvious. Disconnect the user in three feet to step from the seat, and when not in use the shoulder straps retract usefully and completely.

Here, at last, is a new pilot's pattern which provides plug-in convenience...full motion restraint...and maximum safety. SAF-T-MATIC is now in production in wide quantities to complete your needs!



PACIFIC SCIENTIFIC COMPANY

P.O. Box 1018, Los Angeles 22, Calif.

San Francisco, Seattle, Arlington, El Paso, San Diego
 REPRESENTATIVES: Raytheon Co., Aero. Eng. Co.,
 Calside—General Mfg. Corp.

stopped by intentional destruction of the aircraft. They had successfully tracked enough data to identify the de Havilland engineers that they were on the right track.

Further Testing

Tests continued with missile components being added singly to the engine sounds. The next group of tests included both power and control systems to check performance of the coupled units in their response to an imposed signal. Final group of development tests checked the performance of the burning head which locked on a target. However, at this stage the head was not controlling the flight path of the missile but merely according the target position. Indication of the missile illuminated the data back to base.

Test complete missile with open thrust, burning and control system was fired at night at LaBelle. The target was a large heated box frame containing infrared radiation from an airplane. It was several miles away. The Fireseeker hit the target.

While the ground tests were being made, each flight test of a Venom with the Ball form of Fireseeker showed were being done at the Venom's cruise range at Abcoport in Wake. First tests were to check attainment of the results from the Venom.

First live round fired as part of the airplane test program was launched from a static Venom parked near Abcoport and landed down the runway. Purpose of the test was to check the effects on the adjacent airplane air track. There were no signs of damage or of landing of the plane.

Next group of five rounds was fired from the Venom over the Abcoport range to check the performance of the Fireseeker. Night path data were telemetrically recorded.

Target Killed

Next complete and successful live shoot was fired from the Venom at a target airplane which had been installed to simulate the addition of the "meatshooter" jet engine. The sound also worked and the target aircraft, moments recorded, splashed into the water.

De Havilland had several good tests with its test program in that each of the first rounds in certain phases of the tests worked the first time and worked properly. The first booster separation, the first preheated ground launched test and the first air launched operation were all successful. The effects of the large, pulse motor work on the nozzle of the capturing engine was outstanding.

Since the test stages of the Fireseeker program, Abcoport has been



Sidewinder on Its Own

Sidewinder introduced as test missile at LaBelle in North American F-109's underway test during a Supercruise Accelerometer at Eglin AFB, Florida. The missile, produced by General Electric and Piller Corp., has an optimal load (400 lbs) (AW Oct. 21, p. 37).

used for airborne tests of the missile but to range limited the use of high speed target drives and the overcast night sky did hamper the possibility of recovering test results after inspecting the target or viewing the hit of the target itself to determine the lethality of the warhead burst.

The maximum exposure of the missile range at Woomera in Australia was the next place to go and de Havilland arrived there early in 1955.

The Australian-based Avon-powered Sidewinder was the first test vehicle adapted to the Fireseeker. Some initial modifications were necessary. Fireseeker was then mounted under the Sidewinder's wing and a camera plus instrumentation pod was installed in a bludge on the Sidewinder's belly under the cockpit.

Australian Flings

After aerodynamic modeling and other wind tests, the flings began, using Fireseeker jet powered deceleration rate of speeds on the order of Mach 1.1. Since then, continued work has increased the likelihood of the missile, as that today the Fireseeker stands as a useful and usable air-to-air weapon.

The only recognition voiced about the program has been that production of rounds for flight tests on other aircraft has not kept pace with the demand. At least one British aircraft manufacturer has had a weapons development program held up by lack of test rounds for firing tests.

But de Havilland is taking steps to hit the bottleneck. The new factory

at Wulfrida is one of several indications. So are the trials of new machines and equipment during the first of the company's factories here and at Bolton in Lancashire.

Technical service staffs built up by the company to handle test results and field problems are currently putting the first class of Royal Air Force personnel through training and instruction on Fireseeker.

Real estimates of the operational availability of the missile are in its availability with Gloster Javelins before the end of 1955. By that time in Sea Venom and P.1B's enter squadron formations, the production flow should be sufficient to arm them with the Fireseeker right from the start.

High Starting Torque In Missile Actuator

Actuator motor for missile use is handle a rotary actuator with winding rate of 120 rps when opened on 60 cycle a.c., efficiency versus being



insulated into entire stopping motor through a frictionless air-cushion clutch. Inasmuch the device is under test and of rather 60 or 90 cycles will operate at free speeds of less than 100 rps. Units are available delivering up to 10 in./lb at 15 rps.

Starting torque is stated to be equal to running torque and start stops within 20 milliseconds at full-cycle operation and five milliseconds at 400 cycle operation. Manufacturer is Viking Tool & Machine Corp., 23 Main St., Belleville 9, N. J.

Accelerometer Free Of Natural Resonance

Self generating dynamic accelerometers capable of handling accelerations to 1,000Gs is designed to measure and record applications where high-frequency transients or step function inputs are present. Type #420 accelerometer operates over a frequency range of 5 cps to 80 k c., has a flat response of $\pm 0.5\%$ between 5 cps and 40 k c. Accelerations of 5,000Gs will not burn the unit, the output states.

An electrostatic principle—forcing the polar liquid through a porous substance to create an electrical potential across the substance—enables the unit free from any natural resonances and therefore specific in nature, the firm reports.

Consolidated Electrodynamic Corp., 130 N. Santa Anita Villa, Pasadena, Calif.

Alloy Steel Toughness
RESISTS
Heavy-Duty Roughness



Leading gear shaft for the North American F-100C is manufactured by Bendis Products Division, Bendis Aviation Corporation. Exceeding requirements for wear and outer cylinders resulted in the development of a new grade of steel by Bendis and Republic metallurgists working in cooperation with North American engineers.

How Metallurgical Teamwork Developed the Super Sabre's Tough,

When a new grade of steel is born, there's sure to be an interesting story behind it.

In this case, it's the story of close cooperation between metallurgical teams from Bendis and Republic. Their common goal: development of a tough, strong, alloy steel to withstand the shock, impact, strain and vibration of tons of aircraft hitting the runway at speeds in excess of 100 miles per hour.

It starts after World War II, when Bendis metallurgists undertake a program to correct certain characteristics and improve processing deficiencies

of steels commonly used for aircraft landing gear. Several leading steel companies, including Republic, were consulted and the program outlined. Republic immediately put its 3-D Metallurgical Service Team on the problem.

The field metallurgist worked closely with Bendis metallurgists and engineers right in their own plant under actual operating conditions. Their findings were supplemented and coordinated by the other two members of the Republic team—the laboratory and mill metallurgists.

The result: development of a new grade of steel that

Strong, Alloy Steel Landing Gear

was found ideal for application in the strength range of 220,000-240,000 psi. This steel, designated AMS 6427 by the SAE, offers maximum resistance to fatigue. Provides an exceptionally high strength-to-weight ratio. Maintains its great strength at wide temperature extremes. Responds uniformly in heat treatment, producing hard, wear-resistant surfaces around tough cores.

Are you sure you are using the right steel? Why not make sure by using Republic's 3-D Metallurgical Service to assist you in a check-up! It's confidential. There's no obligation, just send us the coupon.



WHILE STRENGTH IS AN IMPORTANT REQUIREMENT—such as this pocket steel for dissipation tests—manufacturers place value for basic construction. At any given weight, tubing is stronger of all standard shapes . . . as a beam . . . in tension . . . under static pressure loads. Republic 1500-KMP® Steel Mechanical Tubing, the inherent ductility resistance enables tubes to well exceed the quality and performance. It's available in carbon and alloys steel in a wide variety of sizes, shapes and gauges. Send coupon for more facts.



HIGH STRENGTH AND LIGHTWEIGHT ADVANTAGES of Republic Tubes in a landing gear, speed and maneuverability in both military and commercial aircraft. In the Navy's F100, sections fabricated from Republic Tubes, Type 60-75, handled air loads in the forward fuselage and engine compartments. But, direction should not be looked upon as strictly an aircraft or military metal, its extremely high resistance to wear forms of corrosion makes it attractive for use in processing and chemical equipment, heat exchangers, ducts, valves, tanks, operating racks, etc. Send coupon for more information.

REPUBLIC



World's Widest Range of Standard Steels

STEEL

and Steel Products

REPUBLIC STEEL CORPORATION
Dept. C-3828 R
3110 East 45th Street, Cleveland 32 Ohio

☐ Have an Alloy Metallurgical call.
Send your information on ☐ INCREASING Mechanical Tubing ☐ Titanium

Name Title

Company

Address

City State



Zenith's F 102A is an advanced supersonic fighter for the Air Force.

Bring your tough ones to Zenith

The sleek, aerodynamic contours of Zenith's F 102A supersonic fighter is a Zenith built machine. It had to be built to serve as a structural part of the airplane—strong enough to punch its way through the turbulence of supersonic flight—tough enough to stand the blistering temperatures. But it also had to be made with all the delicate precision devoted to a fine instrument line, because its real purpose is to select radar beams without disturbing them.

To combine all these qualities, Zenith developed a semi-welded performance structure. It required an extremely close-tolerance balance between resin and glass fiber con-

tent to give it a correct dielectric constant, optimum transmission, and maximum strength.

Not an easy job, but we welcomed it. Through challenges like this, we've learned to form non-bonded glass fiber for almost every electronic and structural purpose. In almost every shape and size—and to produce it by modern production line methods. We can usually simplify the design and bring required tolerances to equivalent metal parts.

Zenith's reinforced plastics are the only answer for many structural components—and a better answer for many. We invite you to "bring your tough ones to Zenith."

Zenith Plastics Company

1600 West 135th Street, Gardena, California
Subsidiary of MacIndoe Molding and Manufacturing Company



World's largest plastic product reinforced structure components for the U.S. Air Force, U.S. Army and U.S. Navy. Applications include aircraft and missile structures, radars and missile guidance systems, antennas and missile wings, radars, fuel tanks, fuel boosters, engine components, engine cowls and fins, radar scanner parts, antenna radomes, ARCS, SH-60s, B-52s, MC-130s, C-130s, C-145s, C-147s, C-17s, C-27s, C-29s, C-30s, C-31s, C-32s, C-33s, C-34s, C-35s, C-36s, C-37s, C-38s, C-39s, C-40s, C-41s, C-42s, C-43s, C-44s, C-45s, C-46s, C-47s, C-48s, C-49s, C-50s, C-51s, C-52s, C-53s, C-54s, C-55s, C-56s, C-57s, C-58s, C-59s, C-60s, C-61s, C-62s, C-63s, C-64s, C-65s, C-66s, C-67s, C-68s, C-69s, C-70s, C-71s, C-72s, C-73s, C-74s, C-75s, C-76s, C-77s, C-78s, C-79s, C-80s, C-81s, C-82s, C-83s, C-84s, C-85s, C-86s, C-87s, C-88s, C-89s, C-90s, C-91s, C-92s, C-93s, C-94s, C-95s, C-96s, C-97s, C-98s, C-99s, C-100s, C-101s, C-102s, C-103s, C-104s, C-105s, C-106s, C-107s, C-108s, C-109s, C-110s, C-111s, C-112s, C-113s, C-114s, C-115s, C-116s, C-117s, C-118s, C-119s, C-120s, C-121s, C-122s, C-123s, C-124s, C-125s, C-126s, C-127s, C-128s, C-129s, C-130s, C-131s, C-132s, C-133s, C-134s, C-135s, C-136s, C-137s, C-138s, C-139s, C-140s, C-141s, C-142s, C-143s, C-144s, C-145s, C-146s, C-147s, C-148s, C-149s, C-150s, C-151s, C-152s, C-153s, C-154s, C-155s, C-156s, C-157s, C-158s, C-159s, C-160s, C-161s, C-162s, C-163s, C-164s, C-165s, C-166s, C-167s, C-168s, C-169s, C-170s, C-171s, C-172s, C-173s, C-174s, C-175s, C-176s, C-177s, C-178s, C-179s, C-180s, C-181s, C-182s, C-183s, C-184s, C-185s, C-186s, C-187s, C-188s, C-189s, C-190s, C-191s, C-192s, C-193s, C-194s, C-195s, C-196s, C-197s, C-198s, C-199s, C-200s, C-201s, C-202s, C-203s, C-204s, C-205s, C-206s, C-207s, C-208s, C-209s, C-210s, C-211s, C-212s, C-213s, C-214s, C-215s, C-216s, C-217s, C-218s, C-219s, C-220s, C-221s, C-222s, C-223s, C-224s, C-225s, C-226s, C-227s, C-228s, C-229s, C-230s, C-231s, C-232s, C-233s, C-234s, C-235s, C-236s, C-237s, C-238s, C-239s, C-240s, C-241s, C-242s, C-243s, C-244s, C-245s, C-246s, C-247s, C-248s, C-249s, C-250s, C-251s, C-252s, C-253s, C-254s, C-255s, C-256s, C-257s, C-258s, C-259s, C-260s, C-261s, C-262s, C-263s, C-264s, C-265s, C-266s, C-267s, C-268s, C-269s, C-270s, C-271s, C-272s, C-273s, C-274s, C-275s, C-276s, C-277s, C-278s, C-279s, C-280s, C-281s, C-282s, C-283s, C-284s, C-285s, C-286s, C-287s, C-288s, C-289s, C-290s, C-291s, C-292s, C-293s, C-294s, C-295s, C-296s, C-297s, C-298s, C-299s, C-300s, C-301s, C-302s, C-303s, C-304s, C-305s, C-306s, C-307s, C-308s, C-309s, C-310s, C-311s, C-312s, C-313s, C-314s, C-315s, C-316s, C-317s, C-318s, C-319s, C-320s, C-321s, C-322s, C-323s, C-324s, C-325s, C-326s, C-327s, C-328s, C-329s, C-330s, C-331s, C-332s, C-333s, C-334s, C-335s, C-336s, C-337s, C-338s, C-339s, C-340s, C-341s, C-342s, C-343s, C-344s, C-345s, C-346s, C-347s, C-348s, C-349s, C-350s, C-351s, C-352s, C-353s, C-354s, C-355s, C-356s, C-357s, C-358s, C-359s, C-360s, C-361s, C-362s, C-363s, C-364s, C-365s, C-366s, C-367s, C-368s, C-369s, C-370s, C-371s, C-372s, C-373s, C-374s, C-375s, C-376s, C-377s, C-378s, C-379s, C-380s, C-381s, C-382s, C-383s, C-384s, C-385s, C-386s, C-387s, C-388s, C-389s, C-390s, C-391s, C-392s, C-393s, C-394s, C-395s, C-396s, C-397s, C-398s, C-399s, C-400s, C-401s, C-402s, C-403s, C-404s, C-405s, C-406s, C-407s, C-408s, C-409s, C-410s, C-411s, C-412s, C-413s, C-414s, C-415s, C-416s, C-417s, C-418s, C-419s, C-420s, C-421s, C-422s, C-423s, C-424s, C-425s, C-426s, C-427s, C-428s, C-429s, C-430s, C-431s, C-432s, C-433s, C-434s, C-435s, C-436s, C-437s, C-438s, C-439s, C-440s, C-441s, C-442s, C-443s, C-444s, C-445s, C-446s, C-447s, C-448s, C-449s, C-450s, C-451s, C-452s, C-453s, C-454s, C-455s, C-456s, C-457s, C-458s, C-459s, C-460s, C-461s, C-462s, C-463s, C-464s, C-465s, C-466s, C-467s, C-468s, C-469s, C-470s, C-471s, C-472s, C-473s, C-474s, C-475s, C-476s, C-477s, C-478s, C-479s, C-480s, C-481s, C-482s, C-483s, C-484s, C-485s, C-486s, C-487s, C-488s, C-489s, C-490s, C-491s, C-492s, C-493s, C-494s, C-495s, C-496s, C-497s, C-498s, C-499s, C-500s, C-501s, C-502s, C-503s, C-504s, C-505s, C-506s, C-507s, C-508s, C-509s, C-510s, C-511s, C-512s, C-513s, C-514s, C-515s, C-516s, C-517s, C-518s, C-519s, C-520s, C-521s, C-522s, C-523s, C-524s, C-525s, C-526s, C-527s, C-528s, C-529s, C-530s, C-531s, C-532s, C-533s, C-534s, C-535s, C-536s, C-537s, C-538s, C-539s, C-540s, C-541s, C-542s, C-543s, C-544s, C-545s, C-546s, C-547s, C-548s, C-549s, C-550s, C-551s, C-552s, C-553s, C-554s, C-555s, C-556s, C-557s, C-558s, C-559s, C-560s, C-561s, C-562s, C-563s, C-564s, C-565s, C-566s, C-567s, C-568s, C-569s, C-570s, C-571s, C-572s, C-573s, C-574s, C-575s, C-576s, C-577s, C-578s, C-579s, C-580s, C-581s, C-582s, C-583s, C-584s, C-585s, C-586s, C-587s, C-588s, C-589s, C-590s, C-591s, C-592s, C-593s, C-594s, C-595s, C-596s, C-597s, C-598s, C-599s, C-600s, C-601s, C-602s, C-603s, C-604s, C-605s, C-606s, C-607s, C-608s, C-609s, C-610s, C-611s, C-612s, C-613s, C-614s, C-615s, C-616s, C-617s, C-618s, C-619s, C-620s, C-621s, C-622s, C-623s, C-624s, C-625s, C-626s, C-627s, C-628s, C-629s, C-630s, C-631s, C-632s, C-633s, C-634s, C-635s, C-636s, C-637s, C-638s, C-639s, C-640s, C-641s, C-642s, C-643s, C-644s, C-645s, C-646s, C-647s, C-648s, C-649s, C-650s, C-651s, C-652s, C-653s, C-654s, C-655s, C-656s, C-657s, C-658s, C-659s, C-660s, C-661s, C-662s, C-663s, C-664s, C-665s, C-666s, C-667s, C-668s, C-669s, C-670s, C-671s, C-672s, C-673s, C-674s, C-675s, C-676s, C-677s, C-678s, C-679s, C-680s, C-681s, C-682s, C-683s, C-684s, C-685s, C-686s, C-687s, C-688s, C-689s, C-690s, C-691s, C-692s, C-693s, C-694s, C-695s, C-696s, C-697s, C-698s, C-699s, C-700s, C-701s, C-702s, C-703s, C-704s, C-705s, C-706s, C-707s, C-708s, C-709s, C-710s, C-711s, C-712s, C-713s, C-714s, C-715s, C-716s, C-717s, C-718s, C-719s, C-720s, C-721s, C-722s, C-723s, C-724s, C-725s, C-726s, C-727s, C-728s, C-729s, C-730s, C-731s, C-732s, C-733s, C-734s, C-735s, C-736s, C-737s, C-738s, C-739s, C-740s, C-741s, C-742s, C-743s, C-744s, C-745s, C-746s, C-747s, C-748s, C-749s, C-750s, C-751s, C-752s, C-753s, C-754s, C-755s, C-756s, C-757s, C-758s, C-759s, C-760s, C-761s, C-762s, C-763s, C-764s, C-765s, C-766s, C-767s, C-768s, C-769s, C-770s, C-771s, C-772s, C-773s, C-774s, C-775s, C-776s, C-777s, C-778s, C-779s, C-780s, C-781s, C-782s, C-783s, C-784s, C-785s, C-786s, C-787s, C-788s, C-789s, C-790s, C-791s, C-792s, C-793s, C-794s, C-795s, C-796s, C-797s, C-798s, C-799s, C-800s, C-801s, C-802s, C-803s, C-804s, C-805s, C-806s, C-807s, C-808s, C-809s, C-810s, C-811s, C-812s, C-813s, C-814s, C-815s, C-816s, C-817s, C-818s, C-819s, C-820s, C-821s, C-822s, C-823s, C-824s, C-825s, C-826s, C-827s, C-828s, C-829s, C-830s, C-831s, C-832s, C-833s, C-834s, C-835s, C-836s, C-837s, C-838s, C-839s, C-840s, C-841s, C-842s, C-843s, C-844s, C-845s, C-846s, C-847s, C-848s, C-849s, C-850s, C-851s, C-852s, C-853s, C-854s, C-855s, C-856s, C-857s, C-858s, C-859s, C-860s, C-861s, C-862s, C-863s, C-864s, C-865s, C-866s, C-867s, C-868s, C-869s, C-870s, C-871s, C-872s, C-873s, C-874s, C-875s, C-876s, C-877s, C-878s, C-879s, C-880s, C-881s, C-882s, C-883s, C-884s, C-885s, C-886s, C-887s, C-888s, C-889s, C-890s, C-891s, C-892s, C-893s, C-894s, C-895s, C-896s, C-897s, C-898s, C-899s, C-900s, C-901s, C-902s, C-903s, C-904s, C-905s, C-906s, C-907s, C-908s, C-909s, C-910s, C-911s, C-912s, C-913s, C-914s, C-915s, C-916s, C-917s, C-918s, C-919s, C-920s, C-921s, C-922s, C-923s, C-924s, C-925s, C-926s, C-927s, C-928s, C-929s, C-930s, C-931s, C-932s, C-933s, C-934s, C-935s, C-936s, C-937s, C-938s, C-939s, C-940s, C-941s, C-942s, C-943s, C-944s, C-945s, C-946s, C-947s, C-948s, C-949s, C-950s, C-951s, C-952s, C-953s, C-954s, C-955s, C-956s, C-957s, C-958s, C-959s, C-960s, C-961s, C-962s, C-963s, C-964s, C-965s, C-966s, C-967s, C-968s, C-969s, C-970s, C-971s, C-972s, C-973s, C-974s, C-975s, C-976s, C-977s, C-978s, C-979s, C-980s, C-981s, C-982s, C-983s, C-984s, C-985s, C-986s, C-987s, C-988s, C-989s, C-990s, C-991s, C-992s, C-993s, C-994s, C-995s, C-996s, C-997s, C-998s, C-999s, C-1000s, C-1001s, C-1002s, C-1003s, C-1004s, C-1005s, C-1006s, C-1007s, C-1008s, C-1009s, C-1010s, C-1011s, C-1012s, C-1013s, C-1014s, C-1015s, C-1016s, C-1017s, C-1018s, C-1019s, C-1020s, C-1021s, C-1022s, C-1023s, C-1024s, C-1025s, C-1026s, C-1027s, C-1028s, C-1029s, C-1030s, C-1031s, C-1032s, C-1033s, C-1034s, C-1035s, C-1036s, C-1037s, C-1038s, C-1039s, C-1040s, C-1041s, C-1042s, C-1043s, C-1044s, C-1045s, C-1046s, C-1047s, C-1048s, C-1049s, C-1050s, C-1051s, C-1052s, C-1053s, C-1054s, C-1055s, C-1056s, C-1057s, C-1058s, C-1059s, C-1060s, C-1061s, C-1062s, C-1063s, C-1064s, C-1065s, C-1066s, C-1067s, C-1068s, C-1069s, C-1070s, C-1071s, C-1072s, C-1073s, C-1074s, C-1075s, C-1076s, C-1077s, C-1078s, C-1079s, C-1080s, C-1081s, C-1082s, C-1083s, C-1084s, C-1085s, C-1086s, C-1087s, C-1088s, C-1089s, C-1090s, C-1091s, C-1092s, C-1093s, C-1094s, C-1095s, C-1096s, C-1097s, C-1098s, C-1099s, C-1100s, C-1101s, C-1102s, C-1103s, C-1104s, C-1105s, C-1106s, C-1107s, C-1108s, C-1109s, C-1110s, C-1111s, C-1112s, C-1113s, C-1114s, C-1115s, C-1116s, C-1117s, C-1118s, C-1119s, C-1120s, C-1121s, C-1122s, C-1123s, C-1124s, C-1125s, C-1126s, C-1127s, C-1128s, C-1129s, C-1130s, C-1131s, C-1132s, C-1133s, C-1134s, C-1135s, C-1136s, C-1137s, C-1138s, C-1139s, C-1140s, C-1141s, C-1142s, C-1143s, C-1144s, C-1145s, C-1146s, C-1147s, C-1148s, C-1149s, C-1150s, C-1151s, C-1152s, C-1153s, C-1154s, C-1155s, C-1156s, C-1157s, C-1158s, C-1159s, C-1160s, C-1161s, C-1162s, C-1163s, C-1164s, C-1165s, C-1166s, C-1167s, C-1168s, C-1169s, C-1170s, C-1171s, C-1172s, C-1173s, C-1174s, C-1175s, C-1176s, C-1177s, C-1178s, C-1179s, C-1180s, C-1181s, C-1182s, C-1183s, C-1184s, C-1185s, C-1186s, C-1187s, C-1188s, C-1189s, C-1190s, C-1191s, C-1192s, C-1193s, C-1194s, C-1195s, C-1196s, C-1197s, C-1198s, C-1199s, C-1200s, C-1201s, C-1202s, C-1203s, C-1204s, C-1205s, C-1206s, C-1207s, C-1208s, C-1209s, C-1210s, C-1211s, C-1212s, C-1213s, C-1214s, C-1215s, C-1216s, C-1217s, C-1218s, C-1219s, C-1220s, C-1221s, C-1222s, C-1223s, C-1224s, C-1225s, C-1226s, C-1227s, C-1228s, C-1229s, C-1230s, C-1231s, C-1232s, C-1233s, C-1234s, C-1235s, C-1236s, C-1237s, C-1238s, C-1239s, C-1240s, C-1241s, C-1242s, C-1243s, C-1244s, C-1245s, C-1246s, C-1247s, C-1248s, C-1249s, C-1250s, C-1251s, C-1252s, C-1253s, C-1254s, C-1255s, C-1256s, C-1257s, C-1258s, C-1259s, C-1260s, C-1261s, C-1262s, C-1263s, C-1264s, C-1265s, C-1266s, C-1267s, C-1268s, C-1269s, C-1270s, C-1271s, C-1272s, C-1273s, C-1274s, C-1275s, C-1276s, C-1277s, C-1278s, C-1279s, C-1280s, C-1281s, C-1282s, C-1283s, C-1284s, C-1285s, C-1286s, C-1287s, C-1288s, C-1289s, C-1290s, C-1291s, C-1292s, C-1293s, C-1294s, C-1295s, C-1296s, C-1297s, C-1298s, C-1299s, C-1300s, C-1301s, C-1302s, C-1303s, C-1304s, C-1305s, C-1306s, C-1307s, C-1308s, C-1309s, C-1310s, C-1311s, C-1312s, C-1313s, C-1314s, C-1315s, C-1316s, C-1317s, C-1318s, C-1319s, C-1320s, C-1321s, C-1322s, C-1323s, C-1324s, C-1325s, C-1326s, C-1327s, C-1328s, C-1329s, C-1330s, C-1331s, C-1332s, C-1333s, C-1334s, C-1335s, C-1336s, C-1337s, C-1338s, C-1339s, C-1340s, C-1341s, C-1342s, C-1343s, C-1344s, C-1345s, C-1346s, C-1347s, C-1348s, C-1349s, C-1350s, C-1351s, C-1352s, C-1353s, C-1354s, C-1355s, C-1356s, C-1357s, C-1358s, C-1359s, C-1360s, C-1361s, C-1362s, C-1363s, C-1364s, C-1365s, C-1366s, C-1367s, C-1368s, C-1369s, C-1370s, C-1371s, C-1372s, C-1373s, C-1374s, C-1375s, C-1376s, C-1377s, C-1378s, C-1379s, C-1380s, C-1381s, C-1382s, C-1383s, C-1384s, C-1385s, C-1386s, C-1387s, C-1388s, C-1389s, C-1390s, C-1391s, C-1392s, C-1393s, C-1394s, C-1395s, C-1396s, C-1397s, C-1398s, C-1399s, C-1400s, C-1401s, C-1402s, C-1403s, C-1404s, C-1405s, C-1406s, C-1407s, C-1408s, C-1409s, C-1410s, C-1411s, C-1412s, C-1413s, C-1414s, C-1415s, C-1416s, C-1417s, C-1418s, C-1419s, C-1420s, C-1421s, C-1422s, C-1423s, C-1424s, C-1425s, C-1426s, C-1427s, C-1428s, C-1429s, C-1430s, C-1431s, C-1432s, C-1433s, C-1434s, C-1435s, C-1436s, C-1437s, C-1438s, C-1439s, C-1440s, C-1441s, C-1442s, C-1443s, C-1444s, C-1445s, C-1446s, C-1447s, C-1448s, C-1449s, C-1450s, C-1451s, C-1452s, C-1453s, C-1454s, C-1455s, C-1456s, C-1457s, C-1458s, C-1459s, C-1460s, C-1461s, C-1462s, C-1463s, C-1464s, C-1465s, C-1466s, C-1467s, C-1468s, C-1469s, C-1470s, C-1471s, C-1472s, C-1473s, C-1474s, C-1475s, C-1476s, C-1477s, C-1478s, C-1479s, C-1480s, C-1481s, C-1482s, C-1483s, C-1484s, C-1485s, C-1486s, C-1487s, C-1488s, C-1489s, C-1490s, C-1491s, C-1492s, C-1493s, C-1494s, C-1495s, C-1496s, C-1497s, C-1498s, C-1499s, C-1500s, C-1501s, C-1502s, C-1503s, C-1504s, C-1505s, C-1506s, C-1507s, C-1508s, C-1509s, C-1510s, C-1511s, C-1512s, C-1513s, C-1514s, C-1515s, C-1516s, C-1517s, C-1518s, C-1519s, C-1520s, C-1521s, C-1522s, C-1523s, C-1524s, C-1525s, C-1526s, C-1527s, C-1528s, C-1529s, C-1530s, C-1531s, C-1532s, C-1533s, C-1534s, C-1535s, C-1536s, C-1537s, C-1538s, C-1539s, C-1540s, C-1541s, C-1542s, C-1543s, C-1544s, C-1545s, C-1546s, C-1547s, C-1548s, C-1549s, C-1550s, C-1551s, C-1552s, C-1553s, C-1554s, C-1555s, C-1556s, C-1557s, C-1558s, C-1559s, C-1560s, C-1561s, C-1562s, C-1563s, C-1564s, C-1565s, C-1566s, C-1567s, C-1568s, C-1569s, C-1570s, C-1571s, C-1572s, C-1573s, C-1574s, C-1575s, C-1576s, C-1577s, C-1578s, C-1579s, C-1580s, C-1581s, C-1582s, C-1583s, C-1584s, C-1585s, C-1586s, C-1587s, C-1588s, C-1589s, C-1590s, C-1591s, C-1

Automatic feeding and setting with...

T-J

Speeds up riveting and clinching!

It's a quick trip to faster assembly and reduced labor costs when you put T-J Riveters and Clinchers in your production line. These performance-proved machines are suited to a wide range of assembly jobs for aircraft, automobiles, farm machinery, riveting jobs of all kinds.

T-3 RIVITORS automatically feed and set solid rivets with high production. Electrically powered Rivator sets solid steel rivets up to 3/4" long. Thread depth 8" to 36".

T-J CLINGHOBS are clenchers with fully automatic operation, controlled by a single foot pedal. Available in Underfeed and Gravity feed models, throat depths 8" to 36".

Send today for these helpful references: Riviera bulletin 645 and 555 . . . Clincher bulletin 555. The Tomkins-Johnson Co., Jackson, Mich.



SWAPS 4 AT A TIME! Another week, another starting role. Incoming new photo "B" twin, William, showed us a result we'd all find new. Exposed with a simple and bold dress reminiscent of a lady in the 1950s. Looked like a young lady and with that matured smile. Good to see!



SPECIAL TWIN EDITION! Includes the 6-shelf, fold-down Mattress Incorporating automatic slippers and playful modern look for creating functional bedroom environment.



T-2 CLIPBOARD adaptable to a wide range of chart and plotting problems. Models and needed accessories listed.



Small Banding Machine

Willow 1/4 1402 Vented Ram Type
Blender is portable and sand-scrapsing 500 in. x 45 in. floor space. Machine can grind the heavy steel type through 180 deg. without repositioning dies or relocating stem being bent. It can handle shapes such as cork, rubber bands, special screws, made loose, channels and flat bars. Blender uses powder as a duplicator which will allow the machine to make an unlimited number of identical parts. Push button control acts as hydraulic-hydraulic drive can be formed the blending. Address: Willow Supply Mfg. Co., 3158 E. Broadway Parkway, Chicago 14, Ill.

clude an electronic timer for greater governor stability, electrical deicing for the blades and spinner, and electronic synchrophasing for synchronization of blade angle.

Safety Provisions

Among measures for people's safety are a means for either forcing the popper(s) to building it at one to the forehead position. Normal functioning is provided by a condition lever which operates a valve directing full pump output to high ports and bypassing the normal popper control. In addition, if the popper tends to rise to the incorrect position, negative feedback is supplied in a circuit which moves the popper back toward the forehead position and continues to operate until the negative tongue condition is eliminated or manual repositioning action is taken.

Harmon Standard says that the SHED has satisfactorily completed compatibility and limited endurance tests on the limited turbojet engine at Allison's test facilities in Tulsa, Okla. Harmon Standard facilities at Woodport, Ind., are

Deliveries on the new propeller will begin next June. The C-119B will be manufactured at Lockheed's Marietta, Ga., plant.



Over 40,000 Moog electro-hydraulic mechanisms [...] comprising more than 700 specific models [...] have been produced. Each model has been designed to deftly solve specific problems by Moog's highly creative engineering staff. The quantity attests the high quality, reliability and efficient volume production through which Moog serves Valves have achieved industry leadership. For competent assistance in solving your hydraulic servo problems, call on Moog's experienced design engineering team.

ELECTRO-HYDRAULIC SERVO MECHANISMS



MOOG VALVE CO., INC., FLORENCE AIRPORT, EAST AURORA, NEW YORK

Research Laboratory, Pasadena, New Jersey



Westinghouse All-Weather System Guides

In any weather, day or night, USAF's BOMARC, operating at supersonic speeds and extreme altitudes, is guided to the target by its Westinghouse command control and target seeker systems.

Take advantage of Westinghouse ability to develop, engineer and produce complete electronic systems for America's defense. Westinghouse Electric Corporation, Air Arm Division, P.O. Box 746, Baltimore, Md. 21205

Deadly BOMARC

YOU CAN BE SURE...if it's

Westinghouse



FM-09 BOMARC, long range, intercepter aircraft, designed and built by Boeing Aircraft Company.

PLANE FAX

by STANDARD OIL COMPANY OF CALIFORNIA



De-icing phone lines in the high Cascades

"Just like being blown!" That's what telephone men say about the Bell helicopters used to blow heavy frost from long-distance lines in Eastern Washington.

"Before they started using our 'copters," says Carl Beale of Economy Pest Control Company, Yakima, Washington, "men on foot had to try to clean the wires by hitting them with poles. Now, the choppers [sic] from our ships do the whole job in a couple of hours."

"Flying around those wires can be tricky, but it's just an other job to us. We do plenty of tough flying but we've

never had a bad accident. Partly because of Cessna Aviatex Goodies. We use it in all our work, and it gives us full power every time we need it. Never fails, plays, either, and that's really something in a helicopter."

"Because of our government flying, we have to make every 600 hours. But using RPM Aviatex Oils, we always take the extra 60 hours we're allowed, and even then the engines are perfectly good when we take them down. From what we've seen, 'RPM' would keep our engines in top shape for 800 hours. It's the best oil we've ever used."

We take better care of your plane



© 1987 RPM, INC. CHEVRON, A SHELL COMPANY. ALL RIGHTS RESERVED.

TIP OF THE MONTH

High winds with gusts can increase the weight of a safety anchor. New 5/8" anchor rope, double-stranded, will make a safe tie down—don't risk your plane for the sake of an older piece of cordage.



Hoist Designed for Transmitter Lifting

The 500 lb. M-1 is one of three hoists used at New York International Airport where it helps remove and replace 50 lb. GME transmitters used for ground-to-air radio communications by the Civil Aeronautics Administration. CAA has purchased 1,300 such hoists for use throughout the country, according to the manufacturer, Galco Corp.

Driver alerts are run to do a job without requiring two men. Either an operator's hand crank to wind in or pay out a cable over a pulley to raise and lower a platform which carries the transmitter apparatus. Built-in safety device automatically locks the platform in position in case of cable or cable failure to prevent damage to transmitter being hoisted.

Height limits of the device range from 1 in. to 48 in. from the floor. Latch is mounted on rubber seal which two sets of slots are secured. Galco Corp., wholly-owned subsidiary of Great American Industries, Inc., is located in Somerville, Mass.

OFF THE LINE

Small volume, high pressure, electric motor-driven, positive displacement hydraulic pump is being produced by Lee Remer Division, Lear, Inc.

Rotary gear pump is designed for in-



stant duty at temperatures ranging from 65F to +250F. Pumping location is fixed per MIL-8-6003 with inlet pressure of 10 psi absolute. Capacities of the unit are 0.035 gpm at 15 psi and 0.038 gpm at 30 psi, both with 1,000 psi discharge pressure. Pump has an average duty rating of 0.035 gpm with 1,600 psi discharge pressure. Volumetric efficiency is 95%.

Flooding section used for airport fuel storage tanks which features a low torque swirl port has been developed by the British firm, The Engine Room Manufacturing Co., Ltd.

Section starts are fitted 12-14 in. below surface of the tank to avoid picking up water and sediment in the bottom of the tank and also to avoid creating a vortex on the surface of the tank during high pumping rates. Former flooding section with recuperated packed type swirl ports where high torque eventually prevented automatic facilities, according to Jones.

Raffle plate across the intake orifice prevents disturbance precipitate in the bottom of the tank in level falls. A foot keeps the orifice from dropping more than 9 in. from the tank bottom. Flow capacities are 250 gpm for a 4-in. diameter orifice and 500 gpm for a 6-in. orifice. Orifice runs are available from 1/8 in.

Only ONE Torque Wrench can be accurately used with . . .

EXTENSIONES AND ADAPTERS

It is mechanically impossible to use a Torque Wrench with adapters or extensions (with accuracy) unless that Torque Wrench has a positive, built-in, fixed load position.

This essential factor of accuracy, unobstructed as opposed to the design and manufacture of some torque tools, can completely defeat their purpose.



how much do you pay for engine service?



too much . . . or too little?

At Delta Aircraft, the price you pay for the reliable engine overhaul that is engine overhaul dismantled at Delta Aircraft, every major part is carefully checked. If the price requires overhaul, then Delta Aircraft's maintenance service the part. If the price is not right for anything, then a new, guaranteed part is sent in to you.

The price of good engine performance is never too much or too little. At Delta Aircraft, the price is right and the product is a reliable, trustworthy engine.



4114 FOREST PARK ROAD
Fremont 1-0771 • OAKLAND 1-2845

Washington Office
Washington Building
1717 15th Street N.E.
Washington, D.C.

New York Office
1375 Avenue of the Americas
New York, N.Y.

For the eyes of
Argus, the all-seeing



rodomes by McMillan... developed ond delivered to meet Canodoir's roll-out date (scheduled 2½ years before)

Named ARGUS after the "watchful guardian" of Greek mythology, Canadair's CL-28 carries the most comprehensive collection of electronic and other detection equipment ever assembled into one aircraft for locating, tracking and "firing" enemy submarines. It has a number of radar "eyes".

The radomes for these "eyes" were developed by McMillan Industrial Corporation.

For the forward aperture, McMillan developed, manufactured and tested one of the largest radomes ever built—measuring 16' long x 8' wide x 8' deep. Tremendous in size, this radome had to be designed to be lightweight yet meet rigid electrical, environmental and structural requirements.

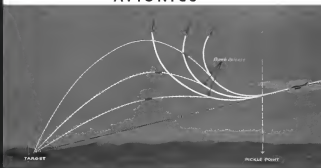
Whether your problem is that of a small, aerospace missile radome, a mammoth aircraft radome or a ground radar system, you can benefit from McMillan's sixteen years of experience in design, manufacture and testing of all types of radomes.

Send for our latest brochure.



McMILLAN INDUSTRIAL CORPORATION
BROWNVILLE AVENUE • SPENCER, MASSACHUSETTS

AVIONICS



M-1 toss-bombing system, used on USAF tactical bombers, gives bombster in chase of target and its required bombing correction.

M-1 Toss Bomb System Light, Simple

By Philip J. Klein

BROOKLYN, N. Y.—Simple, lightweight, easy-to-use, toss-bombing system which translates Low Altitude Bombing System (LABS) (AW July 12, p. 12) but reduces airplane exposure to enemy defenses and gives greater tactical flexibility has been evolved by Air Force.

The M-1 system, an outgrowth of a bombing computer originally developed by Sweden's Saab Aircraft Co., was designed and produced here by Mogenstaler Aerospace Co. System weighs about 15 lb and currently is operational on a number of aircraft, including F-105, F-101, B-57, F-86 and F-84F, company reports.

The M-1 is simple to use. Pilot merely locates target and dives at any angle between 7 and 75 deg. (below horizontal). When target is lined up in sight, bombster, pilot pushes "pickle point" button, then pulls up at about any convenient angle while keeping airplane wings level.

Computer determines precise instant when bomb must be released to hit target and automatically returns to release.

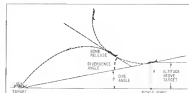
Mogenstaler claims several advantages for system over the Low Altitude Bombing System.

The latter requires use of a landmark whose distance from target is known in order to compute when pullup maneuver must begin, or else the airplane must fly directly over what may be a heavily defended target, then execute an immediate turn to follow an evasive (bushwhacker) route.

The M-1 requires no landmark, permitting its use against targets of opportunity without advance knowledge, and permits the bomber to branch its mission from a considerable distance, not without flying over the target.

Another advantage, according to Mogenstaler's W. G. Grebe, assistant manager of systems engineering, is that M-1 does not require pilot to follow any prescribed pullup maneuver for accurate bomb toss as with the Low Altitude Bombing System.

Another advantage, according to Mogenstaler's W. G. Grebe, assistant manager of systems engineering, is that M-1 does not require pilot to follow any prescribed pullup maneuver for accurate bomb toss as with the Low Altitude Bombing System.



M-1 toss-bombing computer determines correct bomb release point (dive angle plus target distance) from bomber's dive angle and horizontal altitude at pickle point plus other point data.



NOW...weld alloy steels faster ...in any position

with **PaH** Iron-Powder Low-Hydrogen Electrodes

The cost-cutting speed of iron powder enables operators to deposit fast, smooth beads in out-of-position welding by simply dragging the rod. You get excellent feathering-out with exceptionally low spatter — and welds are practically self-cleaning.

In addition, you can get X-ray quality welds with little or no pre-heat, even on "difficult" steels, when you use PaH Iron-Powder Low-Hydrogen Electrodes.

Moreover, low hydrogen prevents underbead cracking and porosity, eliminating cost-

ly reworks. And, because they have a mild steel core, these PaH electrodes cost less than the high-alloy types.

Bulletin R-29 can help you select the exact type of PaH Iron-Powder Low-Hydrogen Electrode you need for high-speed, all-position welding at low cost. Get your copy today. Write Dept. 826H, Harnischfeger Corporation, Milwaukee 45, Wisconsin.

HARNISCHFEGER

PaH WELDERS • ELECTRODES • POSITIONERS
MILWAUKEE 45, WISCONSIN



THREE-part heading system consists of gyroscope, control box, gyro and transducer

inside Heading System. However, the latter can be used at low altitudes where the M1 has a low-altitude limit of about 2,000 ft. On the other hand, the M1 can be employed at high altitudes, up to about 20,000 ft.

Heading Geometry

The M1 employs an extremely simple technique for determining target position at the instant target sights are received on gunnery consoles. If bomber altitude (H) above target and its down angle (θ) relative to horizontal can be measured at the pickoff point, these two measurements define position of target relative to pickoff point and angle of this instant.



THREE-dimensional parabolic-shaped core is heart of M1 heading computer

Down angle can be obtained directly from vertical gyro in the airplane. Aircraft altitude can be established by measuring (barometric) pressure altitude of the airplane and subtracting barometric pressure at the target, previously estimated or determined and set into the computer by the pilot.

Use of barometric pressure to establish target position adds complexity of valve, transducer, cable or radio altimeter. However, it means that barometric pressure at vicinity of target need be known approximately, or estimated. When pressure is unknown, error in many estimated value will produce some aiming error, the amount depending upon error in the estimate, airplane speed and altitude at pickoff point.

Theory of Operation

The Megapholder computer is an analog type device which solves the heading problem in a classical manner by assuming the weapon is dropped in a vacuum, thus entirely neglecting corrections for such practical considerations as head/tail winds and aerodynamic characteristics of the bomb.

From instant the pilot picks the pickoff button and begins his pickoff, the M1 computer continuously translates airplane pitch attitude, measured relative to the down angle at pickoff point. When aircraft pitch angle has increased by an amount equal to what Megapholder calls "the disappear angle" (θ) indicated by the computer, it indicates the bomb release.

Downrange angle computation according to classical vacuum conditions comes continuously built down to a function of aircraft down angle at pickoff point and the ratio of static support pressure measured at the aircraft. Megapholder employs a three-dimensional parabolic ballistic core to compute downrange angle. Core is rotated about

Waugh AERIAL REFUELING FLOWMETER

Waugh model MP-1-G trailing turbine flowmeter has been selected for the tanker version of the Douglas A1D Skywarrior to give precise measurement and control of fuel transfer.



FEATURES:

- Simple, reliable transfer directly in flow control systems; accurate and digital high-to-low intermediate devices
- Signal light in instant transfer of fuel is actuated directly from flow meter
- Slowly rotating turbine rotor is the only moving part—no relays or mechanical switches

Write for complete data: Bulletin 102/WR

Also available: Flow Rate Indicators and Recorders, Frequency-to-Volume Converter, general-purpose Flow Sensors.

Waugh DIVISION
ENGINEERING COMPANY
12101 BAYVIEW AVENUE, SAN DIEGO, CALIFORNIA 92126



PORTABLE M-1, designed by Messerschmitt, permits complete bonding system checkout.

its longitudinal axis is used to serve control in its position corresponds to airplane pitch attitude. Cross deflection axis changes of the airplane until pusher button button which forces into position for direction of the position.

Another sensor system generates a cross deflection along the length of the three-dimensional axis as a function of pressure altitude/pressure ratio based on signals provided by a small transducer. Downward of view of a particular barometric display can follow, rotating shaft of potentiometer whose output voltage is proportional to desired divergence angle based on current conditions.

Data on indicators of weight to be dropped, external winds, engine gage weight and estimated pressure of the target are set into console in pilot panel in attack. The present data, plus signal from vertical accelerometer which is used for augmented-altitude correction, enable computer to modify aforementioned divergence angle equal to compensate for:

- Thrust reverser characteristics
- Distance measured by airplane from pickup point
- Aircraft angle of attack
- Head/tailwind effect on both up- and down after release

Modified divergence angle signal is then compared continuously with the signal proportional to change in air-pitch angle using pickup point. When two angles (signals) are equal, computer releases the bomb.

All computations involving signal voltage is performed on the basis of voltage ratios rather than absolute in-

order to make system independent of variations in power supply voltage. Two identical sensor systems are employed, one of three performing double duty. The sensor system employed to enter the ballistics data is also used with airplane pitch attitude in line for another task when the pilot pushes the pickup button and forces the cross position.

The same sensor supplies that is used to compute computed divergence angle equal with signal representing change in airplane pitch angle from the original deflection angle. Magnetic amplifier, with single turn pickup, are used in each sensor amplifier.

A bread-former circuit, driven from



Simulated Contact Flight

Contact flight display of basic flight information is simulated in new Army Navy panel to using computer which produces stereoscopic orthogonal structure on the TV tube. (AW Nov. 4, p. 36.) Display at left shows assault in level flight terrain in perspective. Another panel at right shows assault with some and right wing down. Analog computer for display was developed by Allen B. De Mont Laboratory.

the same shaft in the ballistics cam, is used to provide the pilot with an increasing light which shows whether seventh pitch angle, attitude and averaged are within suitable range of values to permit successful bomb drop.

Messerschmitt has developed a complete line of line maintenance and repair test equipment for the M-1 system, including a system analyzer which permits bonding run acceleration.

Company has developed new "blast test" with output feeds which can be added to M-1 system to extend its operating range and tactical capability. The expanded system is being evaluated at the Air Force Armament Center, Eglin Air Force, Florida.



• **New Radio Telescope**—At 85 ft. diameter radio telescope, largest of its kind in the United States, will be installed near University of Michigan campus at Ann Arbor, under Office of Naval Research sponsorship next spring. The present 45-ft. dish will employ computer controlling with its polarized with the North Celestial Pole and will be rotated about east-west direction to compensate for earth's rotation. Dish also can be rotated 140 degrees in elevation. Telescope is being designed and built by Raytheon Co.

• **Semiconductor "Beacon of Steadiness"**—New semiconductor industry, built-in equipment to standardize both power and frequency in remote control beacon and diode characteristics is being set up at Simon University by Electronics in Electronics Association (formerly RETMA). New semiconductor laboratory is pro-

Who's Who In Countermeasures

Anticrew defense active in electronic countermeasures in addition to those listed earlier (AW Nov. 26, p. 36) include: Advanced General Electronics Laboratory, Instruments For Industry, MCI, Motion and Systems Inc.

Interest after similar results for countermeasures by Radar Corporation of America for the radio industry. Syracuse University also will test electronic sensor semiconductor to establish whether they have more characteristics as primary source defense.

• **Handy Reliance**—Will chart countermeasures relative to electronic countermeasures, such as atmospheric to be put up on, out per second to up, increase in radar, etc. is available for the analog from Precision Equipment Co., 4411 E. Raintree Ave., Chicago 38, Ill.

• **United Flyer, Airmet**—Taking a cue from TV technology, North American's Anticrew Division is looking to diversify aerial guidance systems with a cover letter addressed to "Missile and Sputnik defense. Are you the victim of a shaky guide platform? Are you confused by shifting antennas, collapsing guidance, doubling language, overnight system, city on console, or unexplained feedback? Do you suffer from the dread three-sec drift? Don't let a chain of events ruin you."

Expansions, Changes In Avionics Industry

Clifton Precision Products Co., Clifton Heights, Pa., has purchased 15,000 sq ft. facility in Coltsville Springs for manufacturing systems and other aviation components. New acquisition will double company's manufacturing capacity.

Other recently announced expansions and changes in the avionics field include:

- **Hydromat, Inc.**, West Newton, Mass., is a newly organized company which will manufacture ac. to d.c. and d.c. to d.c. power supplies and converters employing transistors. Company's address: 140 Washington St.
- **Cable Corp.**, San Diego, has purchased Dupont Inc. of the same firm, expanding the former's line of radio-transmission and electronic control.

• **Assembly Products, Inc.**, has made 2000 sq ft. addition to its machine plant in Dorset Hot Springs, Calif. Company manufactures various aircraft parts.

More Canadian Participation Urged In U.S.-Canada Electronic Defense

By James A. Fines

Quebec City—Present joint U. S.-Canadian defense line, established for ground-to-air integration of electronic defense, is inadequate for present and anticipated needs, according to a Canadian mission member.

K. R. Strick, president of Canadian Avionics Engineers, told a meeting of the Avionics Engineers Association here that the defense line does not provide the depth of radar coverage and capacity for controlling large numbers of aircraft and increased integration necessary for an effective defense against supersonic bombers.

In recommending an immediate program of expansion, he stated, "My one specific recommendation is that Canada participate in the development and construction, installation and operation, of (the Canadian) electronic ground environment. This should be a joint responsibility of Canada's defense plan."

Ground Environment

Present electronic ground environment in Canada includes the DEW line, the MidCanada line and the Pinetree line. The first two lines act as warning nets, alerting the Pinetree defense complex in an impending attack.

Strick said that the existing Pinetree line does not meet the minimum requirements for successful defense against present and anticipated methods of current attack.

To meet these requirements, he said, radar coverage must be expanded to a maximum depth of 700 mi. and the capacity expanded to control a large number of simultaneous interceptions both by ground-to-air radar of the B-57 type, and by air-to-air interception, such as the 1,500 sq ft. CF-105 Arrow.

Sensors for defense against incoming tactical ballistic missiles also must be integrated into the Pinetree line defense and be operational by 1962 at the latest, he said. Such defense requires a highly sensitive long-range detection and automatic control system in the electronic ground environment. This in North America, and therefore Canada's defense need, he added.

According to Strick's estimate, Canada should spend something on the order of \$2 billion in the development and procurement of this electronic ground environment during the next 10 years.

The development of this environment should be a mutually protected

Canadian responsibility, he said.

Development and manufacture of an electronic weapon, which are such important parts of the assault industry in Canada today, he continued, should be for the overall North American inventory on a basis of some equitable sharing of the costs between Canada and the U. S. to achieve at least a full utilization of the Canadian assault industry.

Strick stressed that this policy would appear to be a logical extension of the integration of U. S.-Canadian defense. "The logic appears sufficiently compelling to convince the members to seek American purchases in Canada that might be frustrated by the very potential aircraft losses in Washington."

Canadian Success

He cited the success of Canadian both aircraft such as the CF-105, the success of the CF-105 Arrow, the CF-105 Arrow in evidence supporting a Canadian aircraft sales program to the U. S.

Computer errors on the Canadian electronic ground environment was recommended for the following reasons:

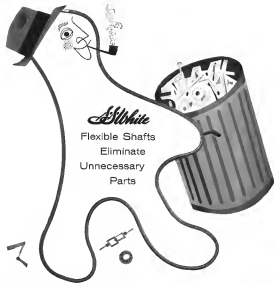
- **No meaningful air defense is possible without it.**
- **Canadian ownership of the ground environment would avoid the RCM in Canada control over all interception, missed and assumed, whether they are Canadian or allied. Such ownership would give Canada a much stronger voice in the integrated North American defense structure and perhaps lead to Canadian acquisition in well.**

• **With civil and military cooperation, most of the electronic ground environment can be developed in one place, and will be accessible so as to attack down and up the line.**

• **Legitimate support of the bases can be an important stimulus in development of air transportation.**

• **Canada could achieve the American of the operation of the Canadian part of the existing ground environment (the complex along the DEW line) which is easily lost to the American joint of view.**

• **Emphasis on ground environment supports a desperately important industry. It would allow for a much more economic procurement in Canada of the electronic ground environment of the industry could support the whole rather than a small part of the total system in Canada.**



Stillwhite
Flexible Shafts
Eliminate
Unnecessary
Parts

One manufacturer used flexible shafts to replace 35 parts in a Hydraulic Power System... cut costs by 90%. Four flexible shafts replaced a 35-part remote-control system... simplified design... made assembly easier... eliminated alignment problems... improved performance!

This is only one of hundreds of remote control and power drive problems these quality

flexible shafts are solving in every industry today. Use S.S. White flexible shafts to help improve your product? Perhaps make it lighter in weight... cut production costs... eliminate unnecessary parts?

If you'd like to know more about flexible shafts, the advice of our engineers costs you nothing. Just write to:



Circle 10 on card to select
and receive flexible shafts
Write for Bulletin 355.

Stillwhite
FLEXIBLE SHAFTS
FLEXIBLE SHAFTS

BUSINESS FLYING



CRUISING RANGE of Tri-Pacer 160 Seaplane, with optional tank, is 125 mi. Demanded for aircraft is high level sports-minded pilot.

Aviation Week Check Flight:

Floats Add Versatility for Tri-Pacer

By Robert L. Stanfield

New York—Typical Tri-Pacer Eight characteristics, coupled with extra power of its high-compression Lycoming O120-B engine, make the 160 Seaplane one to handle and well suited for land-to-water pilot transition. Avianco Wings found an seaplane flight value too.

Tri-Pacer itself is basically similar to previous models (AW Nov '4, p. 114). Main differences lie in internal engine and the 160 hp. Lycoming, which runs 5200 more than the 120 hp. and generates 2,500 rpm at takeoff.

Key features of 160 Seaplane include:
• **Additional 16 hp.** of the O120-B four-cylinder, air-cooled Lycoming. Weight increase with added power is but 6 lb. Compression ratio is 8.5 to 1. Fuel consumption averages 45 lb. of fuel per hp./hr., a 10% saving over former 20 lb.

• **Aluminum skid floats.** Model 99200. Each float incorporates an optional waterlight compartment. Each also will support 2,000 lb. fresh water displacement, leaving a reserve buoyancy of 100% on the fully loaded seaplane.

Seaplane also differs from triplane ground 160 in three respects:

- **Not difference in weight** of 160 lb. due to addition of floats which, with installation, average about 264 lb.
- **Empty weight** of standard seaplane is 1,290 lb. that of wheeled Tri-Pacer is 1,110 lb.
- **Useful load difference** of 218 lb., again due to additional weight of floats.

Total all seaplane is 668 lb., figure for

tricycle-gear Tri-Pacer is 899 lb.

- **Addition of wheel fairing**, which adds to seaplane's stability.

Tri-Pacer was picked up at Sky Flyer Inc. on the Hackensack River, Carlstadt, N. J., for flight in October 1964.

Seaplane we flew was prototype Tri-Pacer 160, Super Customs model, N6841B. With two of its floats, plus 25 gal. fuel (21/96 actual is specified)



USE OF FLATS on island will let Tri-Pacer squawk from "dry" into air.

NEW!

The color film that changed the standards of still photography everywhere is now available as a 16mm motion picture stock.

100

SUPER ANSCOCHROME 16mm FILM

Daylight-exposure index 100

■ This pioneering color emulsion, widely accepted and acclaimed in still work, has been made available in 16mm width for motion picture photography. Its speed of 100 makes it the most useful film for all phases of industrial cinematography where speed and superb color rendition are called for. Super Anscochrome's improved curve conformity, characteristic of all Anscochrome emulsions, provides a color balance that has never been achieved in any other color film. It combines high speed, good latitude, clean highlights and superior shadow area penetration—all so desirable for high speed motion analysis, stress studies and data recording as well as routine work where a reserve of speed is needed. And, Super Anscochrome's high speed does not mean a loss of quality. Its design is such that the speed because an added feature to the already outstanding characteristics of Anscochrome emulsions.

Also available in 35mm and 16mm. Anco, Binghamton, New York. A Division of General Aniline and Film Corporation.



Piper Tri-Pacer 160 Seaplane—Model PA-22

SPECIFICATIONS

Engine	Continental C-125-1, 125-hp, 1,800 rpm
Rp and rpm	1,800
Gross weight (lb.)	1,970
Empty weight (lb.)	1,270
Useful load (lb.)	600
Wing area (sq. ft.)	29.5
Wing span (in.)	147.5
Length (ft.)	22
Height (ft.)	6.6
Prop diameter (diam. in.)	74
Power loading (hp/lb.)	12.2
Wing loading (lb./sq. ft.)	11.2
Rampage capacity (lb.)	300
Fuel capacity (integrated, gal.)	16

PERFORMANCE

Top speed (mph)	117
Cruising speed (75% at sea level, mph)	107
Optimum cruising speed (75% power, 7,000 ft., mph)	112
Stalling speed (mph)	45
Best rate of climb speed (mph)	75
Rate of climb (ft./min.)	770
Best angle of climb rate	65
Service ceiling (ft.)	11,900
Absolute ceiling (ft.)	17,500
Fuel consumption (75% power, gph.)	9
Cruising range (mi.)	400
Cruising range (optional tank) (mi.)	525

5 ft. qt. and, 48 lb. equipment, an airplane grossed out at about 1,933 lb.

Maximum allowable gross weight is 1,970 lb. Seaplane, therefore, is two- or three-place, depending on amount of fuel carried.

Weather conditions were excellent for seaplane transition. Wind was from the SSE at 10 kt. Sea level pressure was 30.01 in. (1013.5 mb). Outside air temperature was 54°F.

Fleet Dimensions

Seaplane yoke from fuselage to water on dolly perpendicular to floats showed five inches of floatage by fuselage by clamshell fittings. No welding is necessary.

Total float area of float is 37 sq. ft. Length of each is 16.1 ft. Main cross height is 22 in., beam 23 in.

Internals, floats, also used as PA-18 seaplane, are finished with two coats of zinc chromate paint. Externals, they get two coats of aluminum lacquer.

Tall float package runs \$1,050, which is added to price quoted for bicycle-powered Tri-Pacer. This includes one float piece of \$2,775, plus \$250 for antistatic at Piper factory, \$60 for float glass let including extra fee, and \$200 for overhauling, which is necessary for salt water operation.

In introducing seaplane, all steel members are unalloyed and sprayed with an epoxy aluminum.

Piper offers seaplane in three models. Standard, priced at \$11,675, Conquest,

get seaplane on the step. Full power was applied and wheel pulled straight back in and in bringing up float.

Seaplane lowered, but down the river, float bolts working against water. Straight ahead visibility wasn't too good with our nose-high attitude. Speed quickly increased to 15 mph and seaplane was riding high on the step.

At this point we noticed back pressure somewhat and seaplane was in second-lift attitude. Full flaps were dropped and we were achieving maximum lift, at about 50 mph.

Seaplane climbed out easily. Flaps were retracted up, we took a turn, at about 100 ft. with no full-on climb. At 1,900 ft., pulling 27.5 in. Hg and 2,500 rpm, we were climbing at between 900-1,000 fpm, and turning speed from 90 to 95 mph.

Specifications indicate 75 mph to be best rate of climb speed. With no right-yielding, no power, we found climb angle at this speed to be too steep. But at 90 mph we got best visibility, good angle and, of course, increased climb speed.

At 2,000 ft., pulling 25.5 in. Hg and 2,500 rpm, we did drop back to 75 mph. IAS and returned 900 fpm rate of climb. Seaplane was quite stable during ascent and with slight turn could be flown hands off.

Engine Settings

We leveled off at 3,000 ft. Outside air temperature was 41°F. We were pulling 24 in. Hg and 2,500 rpm. At 75% power our TAE held about 115 mph. Seaplane is certified at 170 mph. The Tri-Pacer felt comfortable and we didn't have to use our noses to talk. Inside air temperature was held constant during push-pull controls operating forward and back levers.

During flight to Chatter Bay we ran through various degrees of bank and stalls. Interconnected control system made for easy coordination. When wheel was raised, automatic bank seaplane and rubber antistatic-carbide cuts in the ground ahead.

Throughout evaluation seaplane showed stability typical of tri-cycle geared Tri-Pacer.

Seaplane was stalled at cruise attitude, hung on flaps and full flaps, with 15 in. Hg and with power full off.

With no flaps, and power, Tri-Pacer stalled selectively. Lateral stability was good all the way through. Buffeting wasn't very heavy and seaplane broke at about 54 mph IAS. With full flaps, stall again was preceded by buffeting. Stall speed was about 47 mph indicated. There was little trim as keep wings level and seaplane was level of attitude was negligible.

Power off, with no flaps and full stall in a clean stall. Further then,

TMI STAINLESS STEEL TUBING HAS Atomic Experience!



WHAT ENERGY?

Atomic Energy ...
Cosmic ... Solar ...
When America's Most Daring Engineering Tubing Theorists Are Put Into Industrial Practice ... You Can Be Sure That

TMI TUBING WILL BE THERE

* TMI's Atomic Experience is at your service from the initial phase to the final point specification. Depending on quantity and special alloy tubing—wall thickness, 300" to 500" O.D. or such references as 300" to 500" when required.

TUBE METHODS INC.
METALWORKERS • TUBING • RADIATION
HOOVERPORT, Pennsylvania, Co., PA.

was a landing net at 50 mph TAS, which was soon restricted by application of power. When fire was contained, we again began landing well ahead of another landing stall which came at about 35 mph, indicated.

Landing at Oyster Bay was simple: fire, back, of tower and immensity of "waves." We shot about a half dozen, in most instances, applying a bit of power and holding impaled to about 75 mph on approach. With full flaps, and holding nose slightly high so that floats wouldn't dig when we touched down, we'd be suppling into water. As with takeoff, wheel would be pulled full back after touchdown.

Surprisingly, for the first time most of the landings, with the instructions, were satisfactory. Flares would cut smoothly through waves and "landing roll" would quickly stop.

We goaded once, and dropped out once as we retained power too soon. Seaplane hit on ground-out. A little flustered, plus backstick to regain more high altitude, brought her down from the beach.

Throughout succession of landings and takeoffs there, we as pilots landed on windward. Flares held seaplane well balanced in water. Tri-Pacer was quite dry. We didn't even get our feet wet when we hoisted the seaplane.

Bracing and Rebracing

We tried seaplane, extra loads, cutting switch just before forward end of float ran over sand. Before rebracing, light Tri-Pacer was canted back and with water flow striking aimed in wingtip wind off end of float extended out and from which we hopped aboard.

Crossing range of the 160 Seaplane is 410 mi. which with optional eight gal. reserves tank installed, can be crossed in 525 mi.

About 3-4% of total Tri-Pacer pro-

duction has gone to floats, Avionics. With a wet Market is fairly regional and more to big game areas such as New England states, Michigan, Florida, Northwest, Louisiana and Mississippi, etc. Demand for seaplane is also high from sports-minded pilots.

Baggage can be loaded from outside baggage door and all of it can be removed. However, seat can be quickly repositioned to provide 42 cu. ft. of cargo space.

All Tri-Pacer models come equipped with 200 hp, five-cylinder, induction, overhead, dual carburetor, dual ignition, three-speed glider switch, dual fuel pump.

Instruments include: magnum, altimeter, anemometer, compass, oil pressure and temperature, tachometer, fuel gauge, fuel selector, starter, 30 amp generator and 35 amp battery (12.5 volts) are incorporated.

Navigation Equipment

Custom made Tri-Pacer includes navigation and instrument lights. Radio equipment includes Narco VTA 5 27 channel VHF transmitter with frequency spread 118 to 127 mc.; Narco LFR 3 receiver, 200-400 mc.; range 160-1,700 kc. broadcast, radio bearing loop and sensitive altimeter.

Super Cauton includes all personnel, incorporated equipment plus Narco Supermaster radio including VTA 5 and Cauton model with range VIII re-cover of 108 to 127 mc.; 12 channel VHF transmitter, Narco LFR 3 receiver, and following instruments: altimeter, horizon, directional gyro, eight-day clock, ADF group, include all test, generator gauge, rate of climb indicator, turn and bank.

Standard Tri-Pacer color scheme is chosen white with either red, blue or brown, with trimmings to match. Seat covering is Nylonon, which can be dump-proofed.



Champion Makes Foreign Flyaway

Three of four Champion Travelers will be flown, chartered for foreign operations, we show at tomorrow's display at Ocala, Fla., prior to flying delivery. From right to left: fixed and standard Travelers for Chile, equipped to carry cargo tanks and accessories and Traveler for Argentina. Fourth glider, Tri-Traveler for Canada, is out of sight at right.



GRUMMAN SPAYER makes typical approach close pass over Red Hook Airport, Dallas, Tex. during recent demonstration tour in South (AVI News 25, p. 32-33). Wings of spray can be seen coming from floats projecting below wing leading edges. Shortly thereafter, one provides pilot with view over shore. With 220 hp, Grumman model, push-type will take off in 618 ft., at 3,500 lb. gross weight, level stall speed of about 35 mph.

Grumman Displays Spray-Dust Biplanes



CHEMICALS HOPPER, with loading door open, is located just ahead of the single cockpit. It has 25 cu. ft. volume and can take 4,000 lb. of material. Airspeed indicator and tachometer are on just ahead of hopper so pilot can watch instruments without looking down in cockpit while flying. Cockpit covering is heavily padded to protect pilot in event of an accident and area around pilot is especially heated to provide crash safety integrity.



LARGE TAIL is designed to provide good control at low speeds, because structure is in tandem.



PROPELLER driven pump for spray gun, also sprays chemicals in hopper to disperse load evenly.



SPRAY NOZZLES project from booms housed in wing leading edges. Tailoring edges such as this can be used.



SIMPLE LANDING GEAR (below) was constructed sturdy. This version has dual hopper between gear.



PROTOTYPE COOSE CONVERSION, with one of its four supercharged Lycoming D2040 engines in place, details engine mountings for other powerplants. Other features include wing-mounted windshields with additional panels on upper right and left, retractable wingtip floats.

Conversion Gives New Look to Amphibian

New York—Initial interest by business firms in McDonnell Enterprises' low-engine modification of the proven twin engine Cessna 440 amphibian (AWW Nov. 25, p. 23) indicates that firm orders will be placed as soon as the amphibian enters Civil Aeronautics Administration approval.

Several companies have shown their intention to purchase the conversion by buying surplus Cessnas. Coose amphibians and holding them in readiness for completion of the prototype's flight test program at McDonnell's, Sayre, Ore., facility, so as to obtain an early production permit, Airframe West has learned.

Prototype is expected to fly, then certify and final FAA approval will

probably be obtained early next year. The airplane will then be ready to start a nationwide flight demonstration tour in the spring. Although initially only a handful of orders have been indicated to date, company experts to develop reasonable sales volume after it is able to give prospects a first-hand demonstration.

The market potential for the airplane is approximately 50,000 units, a source close to the company told *Airframe West*.

Mer Talking Price

Firm is not yet talking firm prices for the airplane, but a ballpark guess is that if the customer furnishes a basic airframe for conversion, it will cost about

\$125,000 complete. If McDonnell provides the complete package it could run \$280,000-\$325,000. Firm has not yet taken any orders from customers except for one delivery, rather most of the prototype conversion is being borne by McDonnell.

Not will McDonnell detail performance figures until after the flight test program has been completed. Just it feels that the airplane should be able to cruise at 200 mph, time upward at 10,000 ft. on 62% power and will get off the water at 11,000 ft. gross weight in 16 sec.

It places that the airplane will have conventional water landing clearance rates, particularly in landing in swell areas and in water maneuvering, due to

severe pitch feature on all four propellers. Also, the retractable wingtip floats can be stowed individually, permitting the airplane to be brought down alongside a dock for loading or unloading by attaching the proper float and securing the wing over the dock. Recovery features on all four engines will also expedite backing the airplane off a beach.

McDonnell contracted conversion designs to a West Coast aeronautical engineering firm and has been working closely with Civil Aeronautics Administration in getting paperwork approved on, consequently, as it goes along Airframe already has undergone considerable testing, including vibration studies and dead lift loading gear drop tests.

Nature of Revolt

Major aircraft overhaul strengthening landing gear bulkhead to take landing loads that will be imposed by conversion gross weight by 3,000 lb. over design and Coose, carrying a rear baggage bulkhead back to original cabin and provide bracing space. Additional redesign provides for completely new cockpit arrangement including control pedestal windshields and large surface windows in cabin.

A large dorsal fin has been added to provide additional stability for engine-out performance. New a long fuselage, approximately 20 in. with a reinforced plastic structure capable of housing a water-tight engine compartment. New will be buried into the hull and is being installed without disturbing any power structure, Airframe West says. Main landing gear will use Cessna's Mallard mainframe, wheels and brakes, but will replace Coose strut structure.

But, should pilots express preference for wider track gear, McDonnell probably will incorporate Mallard-type struts with shock strut extending from under the wing in later conversions.

Wingtips have been extended 18 in. on each side to provide additional area to handle gross weight increase. Wing covering is now all metal, in place of former metal and fabric covering.

Actuating Systems

Actuating systems have been completely revised—the new airplane uses electrical power for landing gear, flaps, wingtip floats and other services.

Because of the manner in which the airplane is aimed, and because of its price range, McDonnell plans to turn out the initial run at a specialist in the amphibian. It is negotiating with Hottel & Hottel, Ft. Worth custom interior firm, on preparing the prototype for its demonstration tour.

McDonnell Enterprises has considerable experience in amphibian conversions. Founder, a former heavy contractor on ships, aircraft and air conditioning, got into the aviation business by modifying his own Cessna's and Cessna's, now plane, amphibians from *Project to Learning* photographs.

The program worked out to successfully that firm has sold some 75 Super Wedgecraft since then, expects to sell 100 by time number of airplanes available and says McDonnell has since given up his former interests and gone completely into aviation. Aside from negotiating heavy sales in a territory firm roughly west of the Rockies, the firm has a major sales representative, Welch Aviation Co., New York City, which covers area east to the Rockies.

European Trip Made In Aero Commander

President of Southern Sales Sales & Supply Co., Sheffield, Ala., and his administrative assistant recently returned home after a three-week, good will tour of Europe in an Aero Commander 680 Super, visiting customers and sharing latest technology abroad.

The pair left Mobile, Ala., early Sept. 27 and flew to Turin Airport, Italy. John's, Northfield, which is the ideal point for its stretch conversion leg of 1,510 mi. to Lajes Airport in the Azores. From there they flew 1,250 mi. to Lisbon, then to Madrid, Nure, Moscow, Minsk, Rostov, Varna, Zagreb, Geneva, Frankfurt, and Paris. Return trip was via Glasgow through Shannon to the Azores, up to St. John's and back to the starting point.

Turkey journey covered 37,500 mi., took 40 hours, lost 100 lb. and consumed an approximately 2,500 gal.

President Elton H. Dwyer and Pilot J. W. Bender and their service aboard presented no problems; they and Elton and Bender were in luck. Weather was generally good, although they did get ground control approach and instrument landing system approach several times. Language was no obstacle, English being spoken at all control towers, and they saw the language in all radio conversations.

Southern Sales operates five business planes for salesmen, officials and technicians.

Indair Buys Vertols For Oil Exploration

An option for three Vertol V-44A rotary helicopters has been taken by Indair, Inc., a New York firm that is negotiating with a number of U.S. petroleum firms to provide lift of oil exploration sites, primarily in Central and South America. Agreement covers more than \$3 million in helicopter and spares.

If the option is carried through, the transaction marks the first complete commercial sale of Vertol's 150-hp. rotary V-44 type. Manufacturers also is demonstrating safety and creative systems of the configurations.

Indair expects to take delivery of its first V-44A in January or early February 1955 and begin operations early next year, William Gardner, an official of the New York-based AVIATION WEEK Company also has prospects for charter work for oil exploration firms in Alaska, Japan and India. He added: "By the time Indair expects to have its Vertol available. Current prospects are that there will be enough work to keep



LARGE DORSAL FIN has been added to provide engine-out stability. Reinforced plastic release will extend nose about 20 in. Feature of color in extra passenger visibility by use of picture windows. Wingtip floats are actuated by a single electrically operated shaft.



PROTOTYPE'S PANEL has color-coded instrumentation. Aircraft Radio Corp. components and prototype panel with GIP and dual master (left of engine instruments).

104

Prop-jet } AC RELIABILITY Proves



LOCKHEED ELECTRA. A LOCKHEED AIRCRAFT

LOCKHEED ELECTRA—the all new low-engine transport scheduled to enter service in 1958—specifies Allison Prop-jet Engines equipped with AC Spark Igniter Plugs.

Lockheed describes the Electra as the "low-engine type" of plane designed to fly the short, regional air routes as well as transcontinental routes. Cracking from 75 to 100 mph faster than the fastest present-day transport, the cost of the Lockheed's line will cut 20 to 30 percent off most airline schedules without sacrificing efficiency.

AC's reputation for reliability is backed by 14 years of experience in the jet igniter field.



SPARK IGNITER PLUGS

Write: Wall Street Journal, 20002-20003, New York, N.Y.

AC THE ELECTRONICS DIVISION OF GENERAL MOTORS

ten Cessna held a valid annual certificate with an engine transport rating and type stamp in C-46, DC-3 and DC-4 records. The last annual instrument check was passed Dec. 22, 1956 and the last engine check was Aug. 9, 1956. He passed his last flight check Nov. 24, 1956.

Captain Lyle D. Edwards, age 39, was employed by Alaska Airlines from 26, 1947. His flying hours totaled 10,701.51, of which 4,132.76 were in DC-4 equipment. He likewise held a valid annual certificate with an engine transport rating and type stamp in C-46, DC-3 and DC-4 records. His last annual instrument check was passed Oct. 4, 1956, and his last engine check was Oct. 5, 1956. He passed his last flight check July 25, 1956.

Beckman Elmendorf Goods was employed by Alaska Airlines from Jan. 1, 1956. He completed his training period Nov. 30, 1956, and was assigned to flight duty.

Douglas C. 54B DC, N° 56448, serial number 37229, was manufactured Dec. 12, 1944. Flying hours on the aircraft totaled 15,639.01. A continuous maintenance program was conducted by Alaska Airlines. In the annual and all pilot reports and scheduled time expenditures had been made and all discrepancies affecting its structure was last been corrected. The aircraft was equipped with Pratt & Whitney R-2000, 7412 engine and Hamilton Standard propellers, model 20F 54 501, with model 6527-V-3 blades.

Propeller Bearing Blamed in Accident

Washington—Civil Aeronautics Board last week handed down its findings in an accident—one involving an American Airlines DC-7, the other a corporate aircraft. Three persons were killed in the latter crash.

The American Airlines DC-7 lost the nose section and propeller at its No. 1 propeller hub near Memphis, Tenn., last March 3 while en route to San Francisco from New York. Flying parts struck and pierced the passenger fuselage causing explosive decompression, the CAB said. Flying Alaska within the cabin wall the aircraft pressure change resulted in several personal injuries. The aircraft, however, landed at Memphis Airport approximately seven minutes later without difficulty. CAB said probable cause of the accident was failure of the propeller thrust bearing assembly which resulted in the propeller's separation.

The other accident involved a Lockheed Lodestar owned by the United States Steel Corp. and operated by Columbus-Greiner Steel Co., a subsidiary. The plane crashed about five miles north of Tyngsboro, Mass., last Dec. 16, killing the pilot, copilot and a company official. CAB determined that the probable cause of the accident was loss of control for reasons unknown resulting in a rapid descent during which structural failure occurred.



help us build tomorrow's great airliners

Transitional, long-range programs are under way at Rohr for the great commercial jet airliners of the future. These programs include power plants and other major components for the Boeing 707, Caravelle and Lockheed Electra Program.

With over a quarter-billion backlog, more than 30% commercial, Rohr offers experienced aircraft design and stress engineers unusual security and advancement opportunity.

Forward resume today to: F. E. Rohr, Industrial Relations Manager, Rohr Aircraft Corporation, Chula Vista, California, Dept. 47.



ROHR

CHULA VISTA, CALIFORNIA

Chula Vista and Riverside, California

CLASSIFIED **SEARCHLIGHT SECTION** ADVERTISING

BUSINESS OPPORTUNITIES EQUIPMENT - USED or RESALE

The advertising rate is \$20.00 per inch for all advertising agencies or where there is national circulation. Limited rates quoted on request. An ADVERTISING INDEX is prepared by inch vertically on one column, 4 columns wide to be located in one inch. Closing date is 11 days before issue date, subject to space fluctuations.

Send new ads to Classified Advertising Div., Aviation Week, P.O. Box 15, New York 24, N.Y.

DEPARTS

30-35 ft. long, 10-12 ft. wide. The type aircraft shown above is a 30-35 ft. long, 10-12 ft. wide. The type aircraft shown above is a 30-35 ft. long, 10-12 ft. wide. The type aircraft shown above is a 30-35 ft. long, 10-12 ft. wide.

FOR SALE

C-46F AIRCRAFT

Passenger and Cargo

With or Without

T-Category Kit Installed

DC-6C AIRCRAFT

Passenger/Cargo

Immediate Delivery

The Flying Tiger Line Inc.

Burbank, Calif.

Cable or Cable

Fred Benninger

Executive Vice President

Tel: Stanley 7-3411

Cable: Flytiger

WORLD'S LARGEST INVENTORY



C-82 PARTS

Over 200,000 parts in stock. We have the largest inventory of C-82 parts in the world. We have the largest inventory of C-82 parts in the world.

BETTER C-82's

Only 147 C-82's in the world. We have the largest inventory of C-82's in the world.

STEWART-DAVIS, INC.

1001 10th St., P.O. Box 211, Gardena, Calif.

SPARKPLUGS WANTED

1000 South St. Gardena, Calif.

SEIZING THE INDUSTRY IS SUPPLIER OF ORIGINAL PARTS AND EQUIPMENT

FARRAR AVIATION

1000 South St. Gardena, Calif. 90247

PAC

OVERHAUL • SALE • EXCHANGE • LEASE

AR Models Post & Whitney Engines

R985 R1340 R1830

R2000 R2600

Includes an overhaul 1200 engine (4-cylinder) for comparison to the R985-AR. Available immediately or upon scheduled delivery.

Write Please in Cable today

1000 South St. Gardena, Calif. 90247

Immediate Delivery

We stock and sell

NAVCO R1830 R1830

R985 R1340 R2000

and we will provide 1000 engine

R1830 - R1830 - R1830

ENGINE WORKS

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

1000 South St. Gardena, Calif. 90247

193

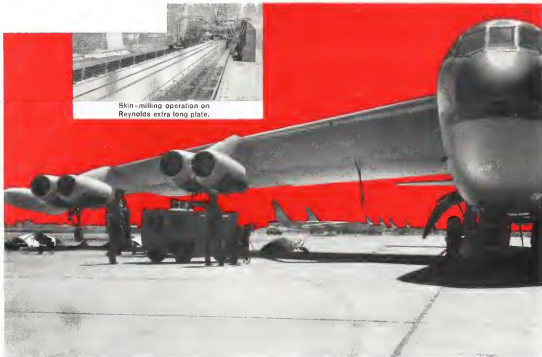
2

WITH A COMPLETE BENDIX SYSTEM FOR FUEL METERING AND ENGINE CONTROL

7



Skin-milling operation on Reynolds extra long plate.



CUTS SEALING PROBLEMS, WEIGHT, COST ...carved aluminum plate in Boeing wing

The largest single piece of "sculptured" aluminum plate on a production airplane is the B-52's lower wing panel, supplied by Reynolds.

Serving as a fuel tank wall as well, this plate eliminates doublers and chordwise splices in wing sections. This in turn prevents local deflection and sealing problems. It also helps save important, costly man-hours of production time.

And, of course, lightweight sculptured aluminum plate saves weight where pounds are precious.

With equipment like the new giant stretcher at its McCook, Ill., plant, only Reynolds has a completely integrated mill for producing extra-large aluminum plate in required high-strength alloys. This service is typical of the wide-ranging demands Reynolds constantly meets for the aircraft industry . . . and a good reason for making this your major source for high-quality aluminum sheet and plate.



Write today for details on Reynolds expanded facilities, and for index of our technical handbooks and films. Reynolds Metals Company, P.O. Box 1800-TJ, Louisville 1, Ky.



For below-mill quantities of AND sections and other aircraft shapes, contact our specialty aircraft extrusion distributor, Pioneer Aluminum, Inc., 5251 W. Imperial Highway, Los Angeles 45, Calif. Phone: ORegon 8-7821.

Watch Reynolds All Family Television Program "DISNEYLAND", ABC-TV.